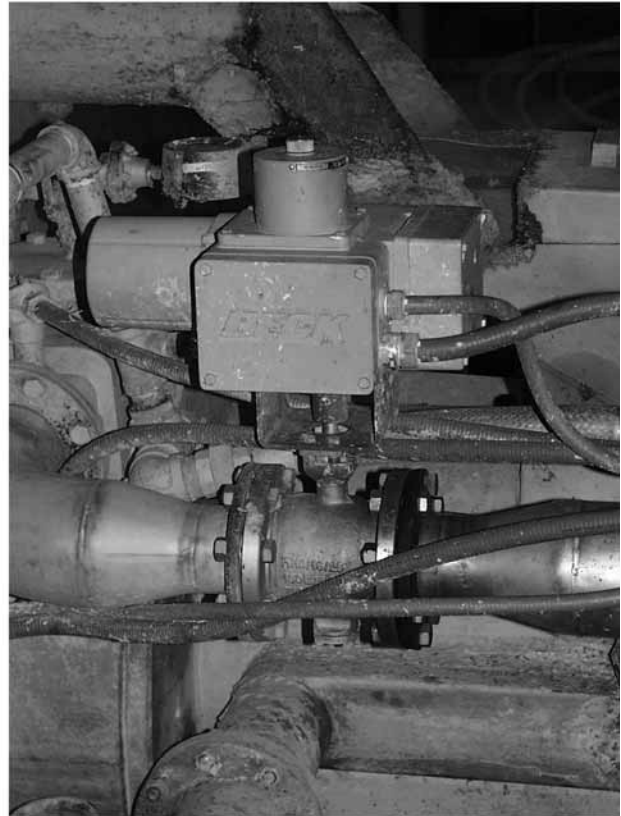
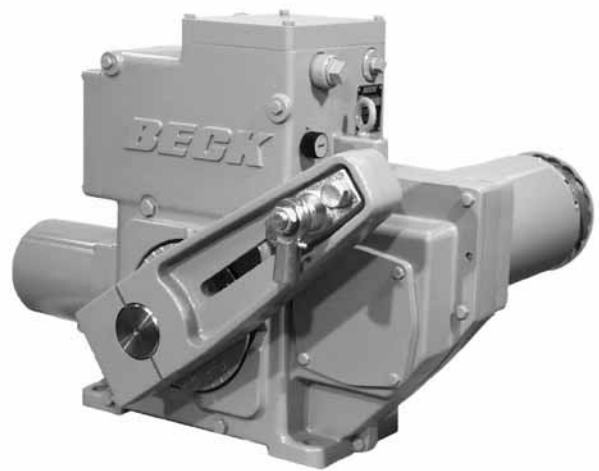
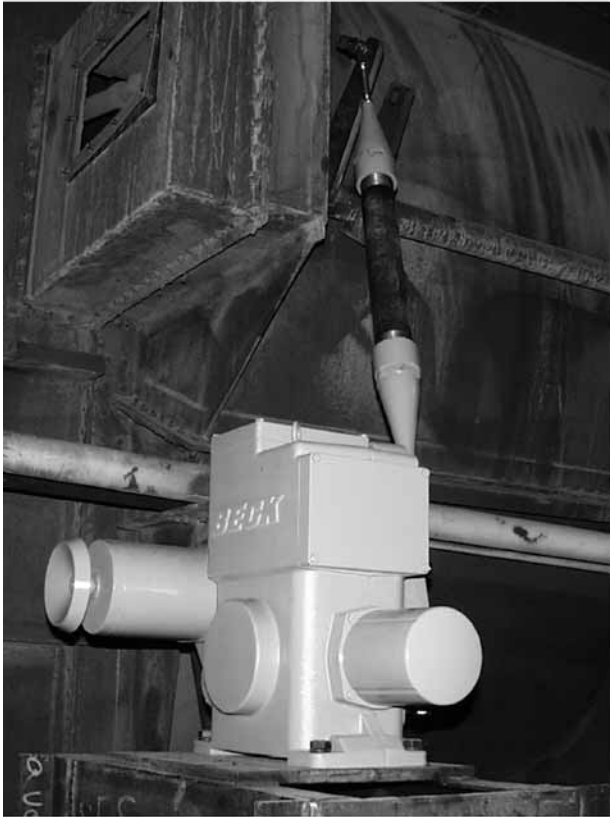




# INSTRUCTION MANUAL

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# INTRODUCTION TO THE MANUAL

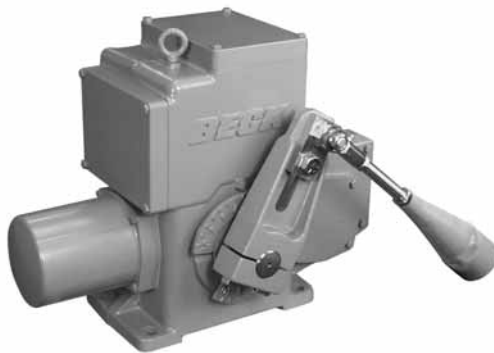
This manual contains the information needed to install, operate and maintain Beck Model Group 11 Electronic Control Drives equipped with the Digital Control Module (DCM-2), manufactured by Harold Beck & Sons, Inc. of Newtown, Pennsylvania.

The Group 11 drive is a powerful control package designed to provide precise position control of dampers, valves, fluid couplings and other devices requiring up to 1,800 lb-ft (2 440 N•m) of drive torque.

**IMPORTANT: This manual contains information that will make installation simple, efficient and trouble-free. Please read and understand the appropriate sections in this manual before attempting to install or operate your drive.**

**This manual also applies to Group 11 & 11E hazardous location drives and, with such orders, is provided along with Beck Manual Supplement 80-1100-14.**

The Beck Group 11 fills an industry need for a reliable electronic control drive. Exceptionally stable and trouble-free, these rotary drives are in use throughout the world in valve and damper applications.



**Group 22 digital control drives ...** are designed for accurate, reliable, digital control in high torque applications. The drive is ideal for use in large boiler applications, such as ID/FD fan dampers.



**Group 14 linear drives ...** are ideally suited for globe valves from 1" to 8" (25 to 203 mm) diameter. Beck's unique "Tight-Seater™" coupling provides positive seating of valves.

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# PRODUCT DESCRIPTION

Beck control drives are engineered for precise, reliable operation of dampers, quarter-turn valves and fluid drives. The cool, stable operation of Beck's control motors coupled with the powerful gear train provide the tight, responsive control required by modern control loops to optimize output while keeping operating costs low.

The unique all spur gear construction used in the Beck control drive is designed for long term durability. Gear modules and motors can be interchanged in the field to alter the torque and timing as needed if the application requirements change. Mechanical stops in the gear train prevent overtravel.

An easy to turn, spoke-free Handwheel is incorporated into the design to allow manual operation during installation or power outages. The Handwheel can be used to move dampers and valves to any position smoothly and easily under full load conditions.

Dampers and valves may also be operated at their individual locations with built-in electric Handswitches.

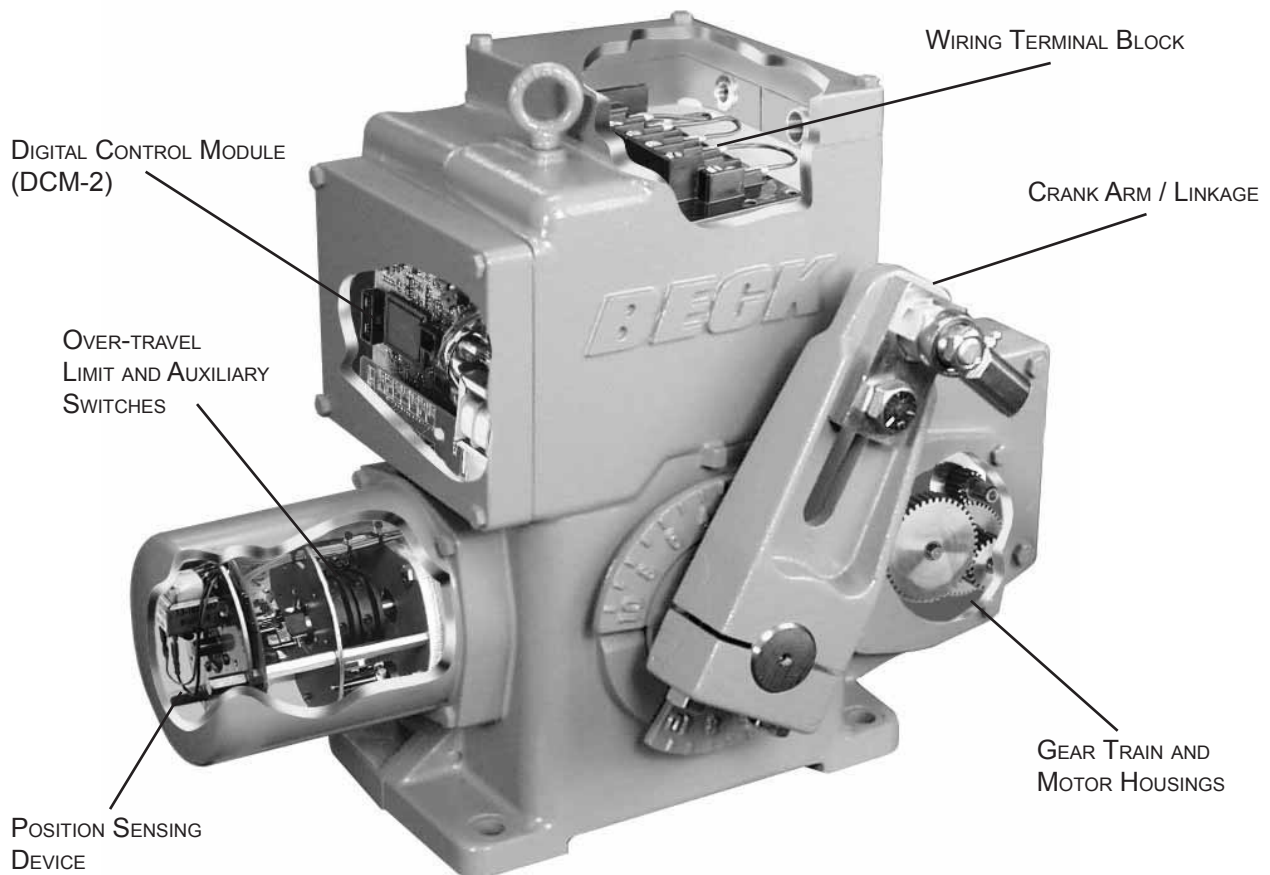
The heavy-duty crank arm (if applicable) of these control drives can be field-adjusted to travel anywhere in the 360° range. The forged rod end fitting may be field-adjusted to any point in the cast

slot of the crank arm. Special linkage arrangements allow total application versatility for connection directly on or remote from the driven load.

Beck's Digital Control Module (DCM-2) provides precise drive control in response to a modulating Demand input signal. It also provides intelligent calibration, easy drive setup changes, and diagnostic information. A local interface provides quick pushbutton setup and diagnostics without the need for a handheld or remote device. A HART® communications interface allows remote access of all features and information. A serial interface also allows for drive configuration changes, drive information reporting and to assist in troubleshooting.

Beck's CPS-2 Contactless Position Sensor provides accurate position measurement in demanding environmental conditions, with no contacting or wiping surfaces to wear or intermittently lose contact. The CPS-2 provides infinite resolution with linearity error of less than ±1% of span over full control drive travel.

Beck electronic control drives are designed with individual weatherproof enclosures to protect the main components. The cutaway illustration below is intended to provide the user with a basic orientation to the product.



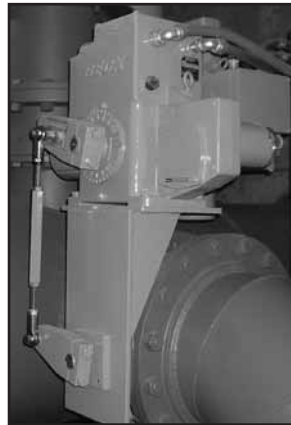


## TYPICAL APPLICATIONS

Beck control drives are ideally suited for use on ball, plug and butterfly valves, as well as dampers and fluid drives. When equipped with a sheave and multi-turn option (consult your Beck Sales Engineer for details), the drive can be used to raise and lower a weight-balanced damper.

DCM-2 equipped Beck drives are designed for precise position control in modulating applications. The drive is best utilized when its full travel is employed to achieve its greatest sensitivity and resolution, although the driven device may operate through a considerably smaller range. Beck drives can be configured with special linkage to deliver greater torque where needed, so that drive size and resultant cost can be minimized.

Valves can be furnished by Beck as unitized assemblies with control drives mounted and tested in the factory. Depending on the valve and application, valves can be mounted directly or using a bracket and linkage. Also, drives may be installed in the field with mounting hardware furnished by Beck or the customer. Drives for dampers are generally installed at the site on a mounting platform separate from the damper.



## BECK LINKAGE KITS

Beck hex and pipe linkage kits are available for completing the mechanical connection from the drive crank arm to the load. Through the use of a standardized selection, the linkage can be ordered even if the exact length is not determined until the drive and driven device are installed.

All Beck foot-mounted drives are furnished with a crank arm and rod end (see pages 8, 10 and 13 for dimensions). All rod ends furnished by Beck incorporate bearings to accommodate some lateral misalignment. Once the connection is made, linkage kits can be adjusted  $\pm 1 \frac{1}{2}$ " (38 mm) without removal of the crank arm or load lever, making final mechanical calibration simple.



# PRODUCT DESCRIPTION

## GENERAL SPECIFICATIONS—ALL MODELS

Drive Power	120 V ac single-phase 50 or 60 Hz 240 V ac single-phase 50 or 60 Hz	Allowable Tolerance	+10% -15%
Model	Max. Current and Power		
	120 V ac		240 V ac
11-159, -169	.40 A      48 W	.20 A      48 W	
11-209, -269	.65 A      78 W	.33 A      78 W	
11-309, -369	.65 A      78 W	.33 A      78 W	
11-409, -469	3.10 A     400 W	1.55 A     400 W	
Operating Conditions	-40° to 185°F (-40° to 85°C) 0 to 100% relative humidity		
Communication Interface	HART protocol (Rev. 5 -- burst mode is not supported), local pushbutton/LED panel and RS-232 Serial commands.		
Demand input Signal Options (DCM-2)	4–20 mA (1–5 V dc input is possible with the removal of the "R11" resistor located on the DCM-2 board (see diagram on page 78).		
Adjustability for Split Range Operation	0%: 0.1 V to 4 V dc 100%: 0% + 1 V min. to 5 V max.		
Step Size	0.15% typical (configurable).		
Linearity	±1% of span, max. independent error		
Hysteresis	0.25% of span at any point		
Demand input Signal Characterization	Linear: Drive output shaft moves proportionally to the input signal. Square: Drive output shaft moves proportionally to the square of the input signal. Custom: Drive output shaft moves according to the custom demand response curve.		
Position Feedback Signal for Remote Indication	4–20 mA		
Isolation	Demand input and position Feedback signals are isolated from ground and the ac power line. Signal buffering provides 24 V dc isolation between the Demand and Feedback signals.		
Action on Loss of Power	Stays in place		
Action on Loss of Input Signal (Power On)	Stays in place or drives to any preset position (configurable).		
Stall Protection (Optional)	If the motor tries to run in one direction for more than 300 seconds (configurable from 30 to 300 seconds), the DCM-2 will shut off power to the motor (feature can be enabled/disabled).		

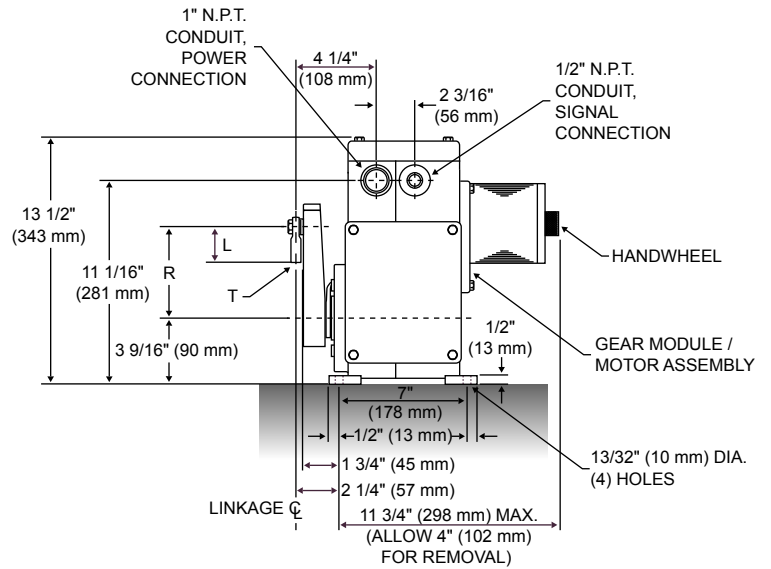
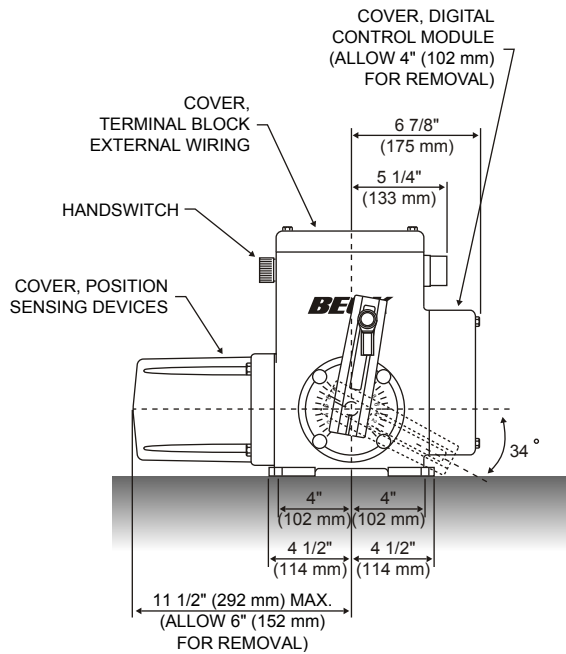
## GENERAL SPECIFICATIONS—ALL MODELS (cont'd)

Overtorque Protection (Optional)	If the output torque of the drive exceeds 150% (adjustable from 70% to 150%) of the drive rating, the motor will shut off (feature can be enabled/disabled).
Alarm Annunciation	Available at terminal E.
Temperature Indication	Measures the internal temperature of the drive and triggers an alarm when the temperature exceeds the rating range.
Over-travel Limit Switches	Two SPDT (CW and CCW) provide over-travel protection.
Auxiliary Switches	Up to four 6 A, 120 V ac switches available. Switches are labeled S1 to S4 and are cam-operated, field-adjustable. Unless otherwise specified, auxiliary switches are factory set: S1 and S4 are set to operate just before reaching the CCW travel limit. S2 and S3 are set to operate just before reaching the CW travel limit.
Handswitch	Permits local electrical operation, independent of controller signal. Standard on all units. An auxiliary contact is available for auto indication (rated 2.5 A at 120 V ac).
Handwheel	Provides manual operation without electrical power.
Motor	120 V ac, single-phase, no-burnout, non-coasting motor has instant magnetic braking. Requires no contacts or moving parts.
Gear Train	High-efficiency, precision-cut, heat-treated alloy steel and ductile iron spur gears. Interchangeable gear modules permit field change of timing.
Mechanical Stops	Prevent overtravel during automatic or manual operation.
Enclosure	Precision-machined, aluminum alloy castings painted with corrosion-resistant polyurethane paint provide a rugged, dust-tight, weatherproof enclosure. Drives designed for hazardous classified locations are also available. NEMA 4X; IP68, 3 meters/48 hours*. *Internal water damage is not covered by warranty.
Mounting Orientation	Any orientation—no limitations.
Standards*	UL Listed CSA Listed CE Compliant

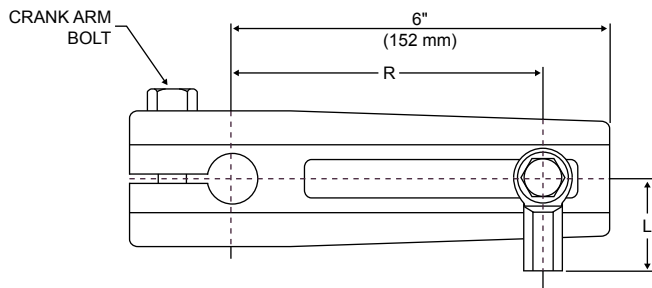
\*NOTE: For standards not specifically listed, please call Beck for more information at 215-968-4600.

# OUTLINE DIMENSION DRAWINGS

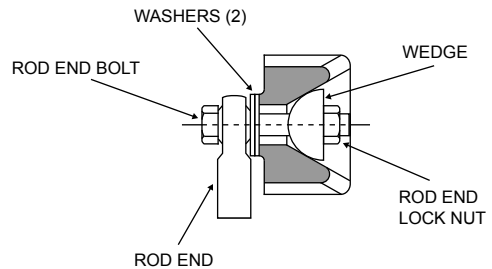
## MODEL 11-159 SPECIFICATIONS



### Crank Arm



ADJUSTABLE RADIUS "R" 1 1/2" (38 mm) TO 5 1/8" (130 mm)



### Recommended Bolt Torques

	Size (in.)	Torque	
		(lb-ft)	(N•m)
Crank Arm Bolt	1/2-13	75	102
Rod End Bolt	1/2-13	35	47
Rod End Lock Nut	1/2-13	55	75
Cover Bolts	5/16-18	10	14
Motor/Gear Module Bolts	1/4-20	6	8
Body Bolts	5/16-18	10	14
Body Bolts	3/8-16	20	27

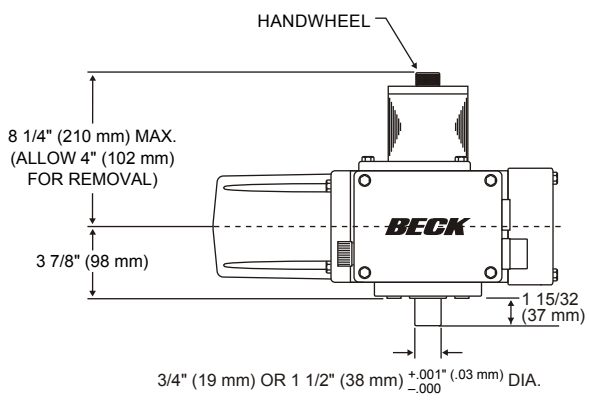
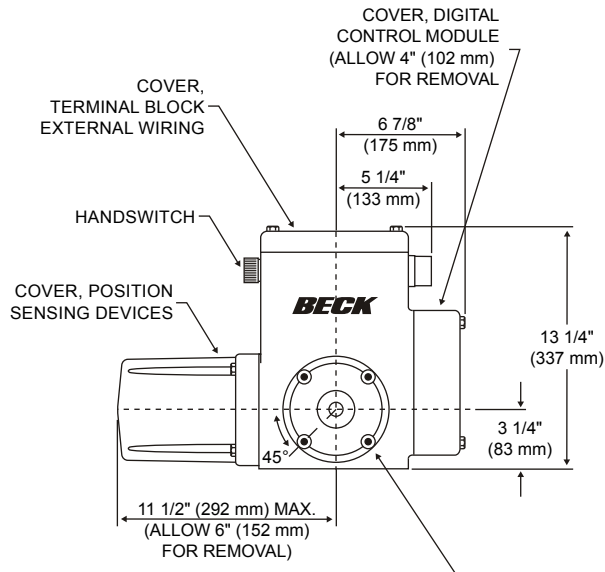
NOTE: All dimensions subject to change.

### Model 11-159 Linkage Part Numbers & Model Information

Crank Arm Assembly	10-3491-05
Crank Arm	10-3491-02
Crank Arm Bolt	30-0306-56
Washers (2)	30-0313-03
Wedge	11-8060-02
Rod End Bolt	30-0306-56
Rod End Lock Nut	30-0309-11
Rod End	12-2840-02
Dim. "L" (Length)	2.125" (54 mm)
Dim. "T" (Thread)	1/2-20 x 1-1/8" (29 mm)
Output Shaft Dia.	3/4" (19 mm)
Approx. Weight	50 lbs (23 kgs)
Max. Overhung Load	750 lbs (340 kgs)



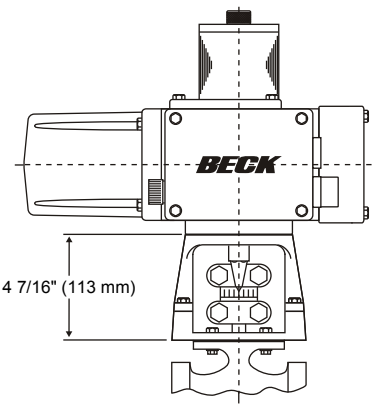
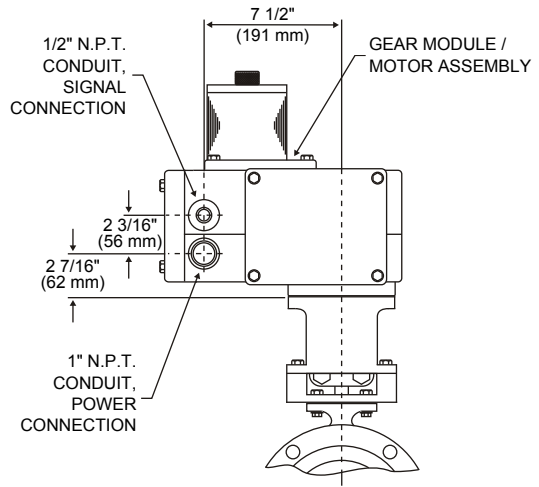
# MODEL 11-169 SPECIFICATIONS



**BASIC CONTROL DRIVE**

## Model Information

Approximate Weight	56 lbs. (25 kg)
Maximum Overhung Load	750 lbs. (340 kg)



**TYPICAL VALVE MOUNTING**

## Recommended Bolt Torques

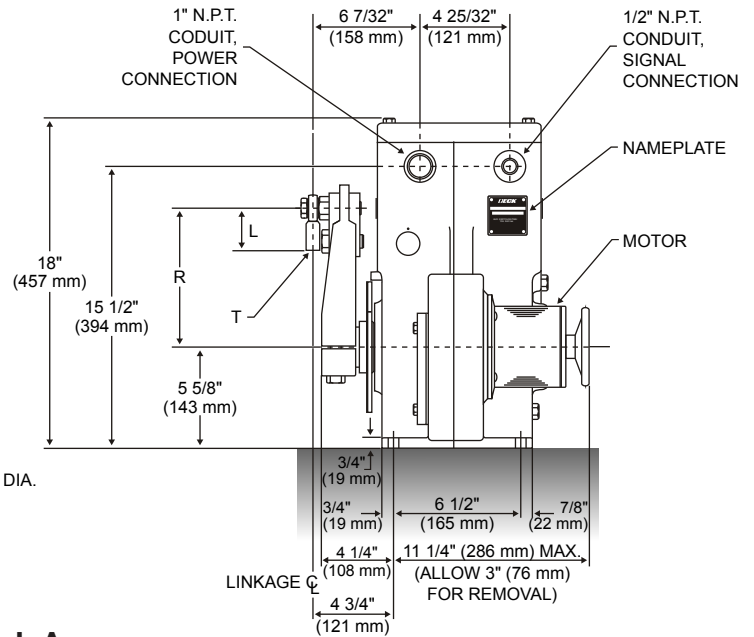
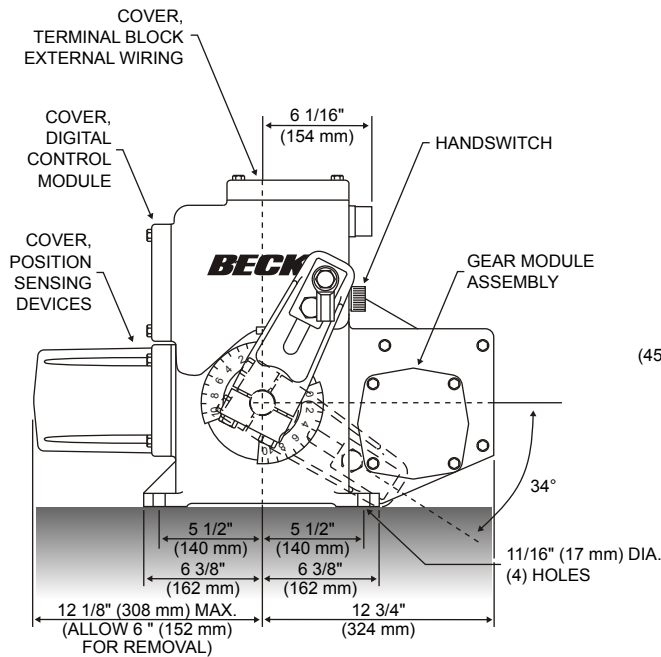
	Size (in.)	Torque	
		(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Motor/Gear Module Bolts	1/4-20	6	8
Body Bolts	5/16-18	10	14
Body Bolts	3/8-16	20	27
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	3/8-24	50*	68*
Mounting Bracket Screws (Flat Head)	3/8-16	25	34

\*May vary per application. Refer to valve mounting specification sheet shipped with your drive.

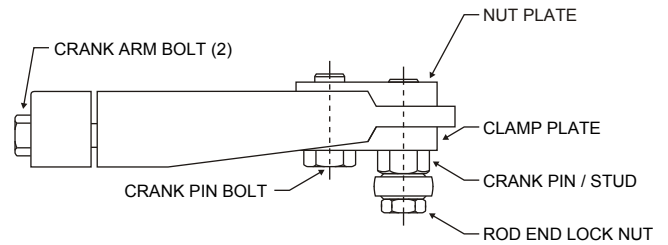
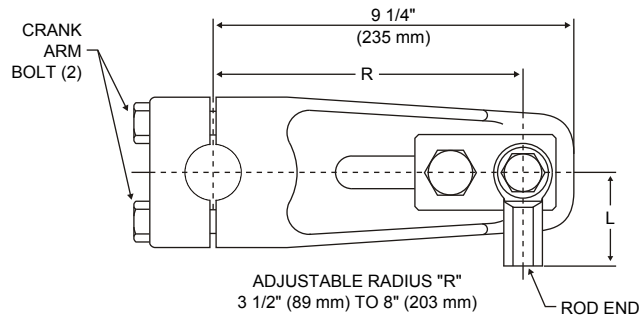
NOTE: All dimensions subject to change.

# OUTLINE DIMENSION DRAWINGS

## MODEL 11-209 & 11-309 SPECIFICATIONS



### Crank Arm



### Model 11-209 / -309 Linkage Part Numbers & Model Information

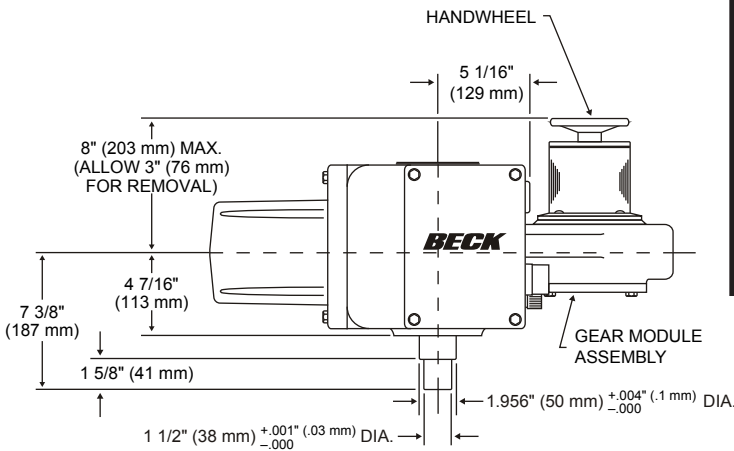
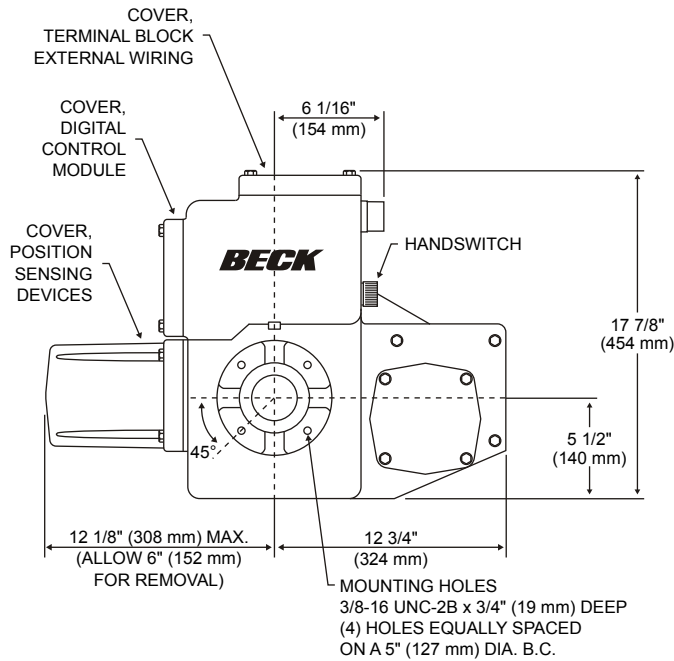
#### Recommended Bolt Torques

	Size (in.)	Torque	
		(lb-ft)	(N•m)
Crank Arm Bolt	5/8-18	240	325
Crank Pin Bolt / Stud	3/4-16	300	407
Crank Pin Bolt / Stud	3/4-16	300	407
Rod End lock nut:			
(11-209)	1/2-20	35	47
(11-309)	5/8-18	65	88
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Cover Bolts	5/16-18	10	14
Motor Bolts	1/4-20	6	8
Gear Module Bolts	5/16-18	10	14

	11-209	11-309
Crank Arm Assembly	14-7330-26	14-8010-34
Crank Arm	14-8008-02	14-8008-01
Crank Arm Bolt (2)	30-0308-75	30-0308-75
Clamp Plate	14-9883-01	14-9883-01
Crank Pin / Stud	14-9920-06	14-9920-07
Crank Pin Bolt	30-0308-61	30-0308-61
Nut Plate	14-9883-02	14-9883-02
Rod End Lock Nut	30-0309-19	30-0309-23
Rod End	12-2840-02	12-2840-03
Dim. "L" (Length)	2 1/8" (54 mm)	2 1/2" (64 mm)
Dim. "T" (Thread)	1/2-20 x 1-3/16" (30 mm)	5/8-18 x 1-1/2" (38 mm)
Output Shaft Dia.	1 1/2" (38 mm)	1 3/4" (44 mm)
Approx. Weight	120 lbs (54 kgs)	125 lbs (57 kgs)
Max. Overhung Load	3,000 lbs (1,361 kgs)	4,500 lbs (2,041 kgs)

NOTE: All dimensions subject to change.

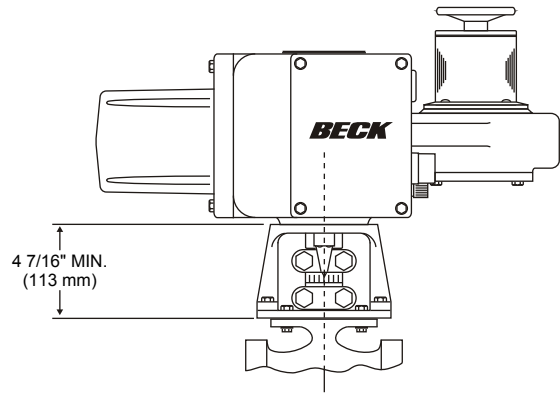
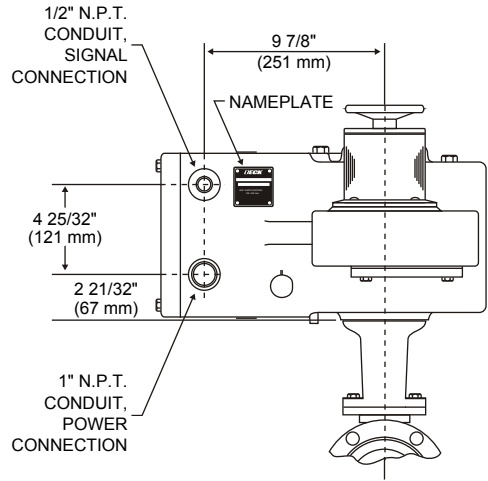
# MODEL 11-269 SPECIFICATIONS



## BASIC CONTROL DRIVE

### Model Information

Approximate Weight	115 lbs. (52 kg)
Maximum Overhung Load	3,000 lbs. (1 361 kg)



## TYPICAL VALVE MOUNTING

## Recommended Bolt Torques

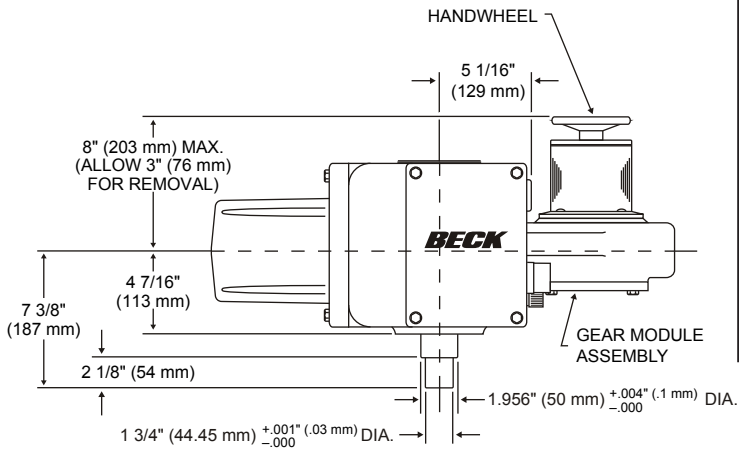
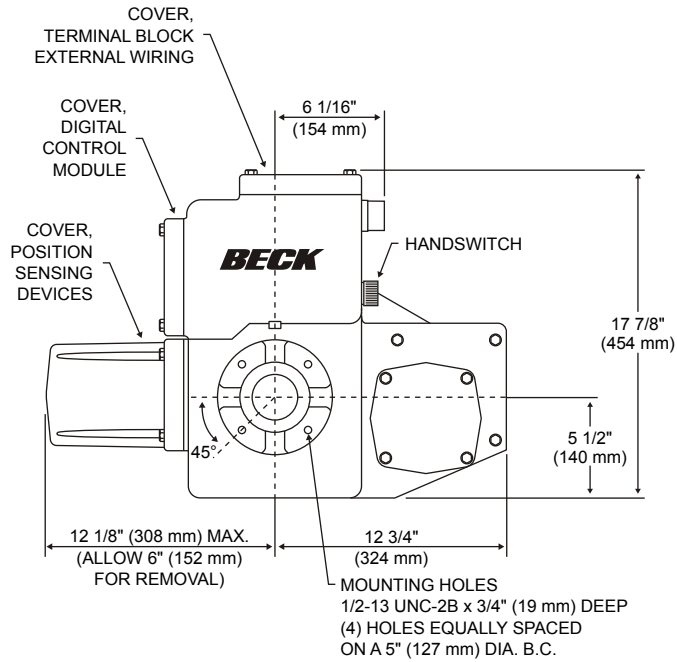
	Size (in.)	Torque	
		(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Gear Module Bolts	5/16-18	10	14
Motor Bolts	1/4-20	6	8
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	5/8-18	170*	230*
Mounting Bracket Screws (Flat Head)	3/8-16	25	34

NOTE: All dimensions subject to change.

\*May vary per application. Refer to Valve Mounting Specification sheet shipped with your drive.

# OUTLINE DIMENSION DRAWINGS

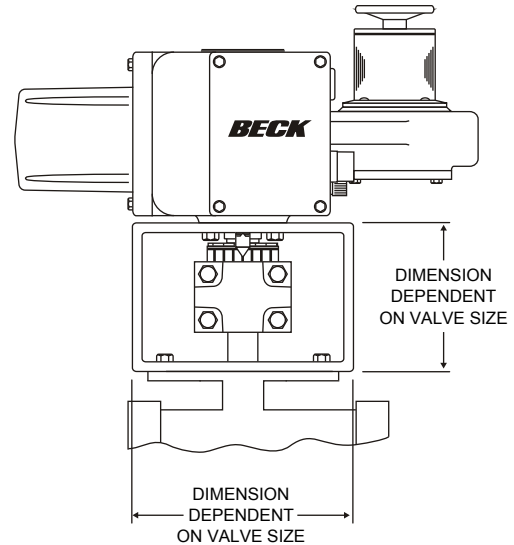
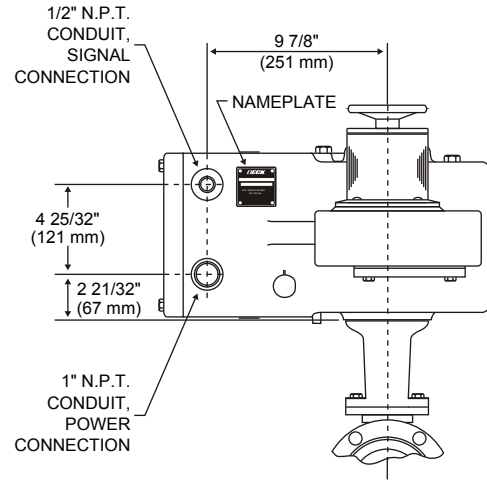
## MODEL 11-369 SPECIFICATIONS



**BASIC CONTROL DRIVE**

### Model Information

Approximate Weight	115 lbs. (52 kg)
Maximum Overhung Load	4,500 lbs. (2 041 kg)



**TYPICAL VALVE MOUNTING**

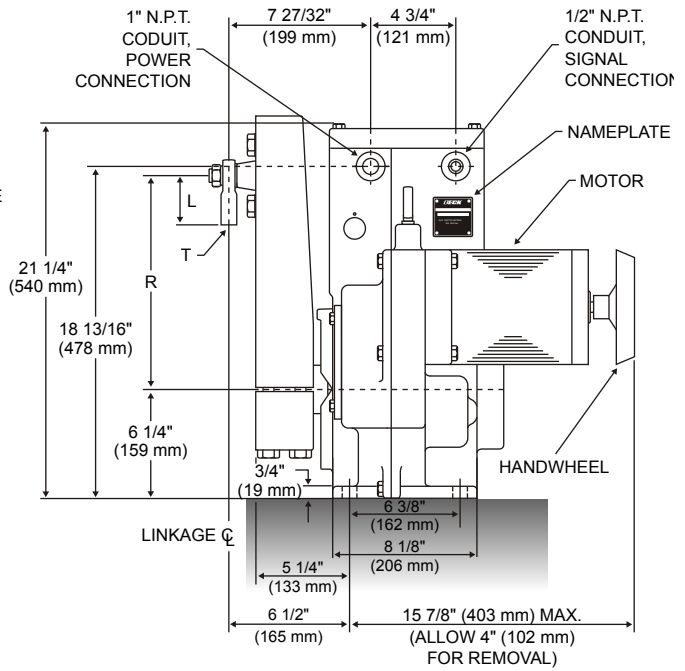
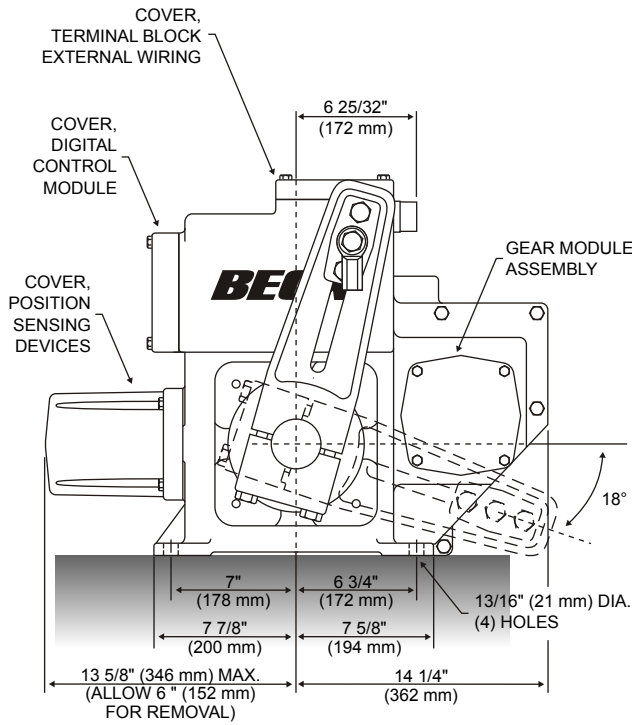
### Recommended Bolt Torques

	Size (in.)	Torque	
		(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Gear Module Bolts	5/16-18	10	14
Motor Bolts	1/4-20	6	8
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	5/8-18	170*	230*
Mounting Bracket Screws	1/2-13	50	68

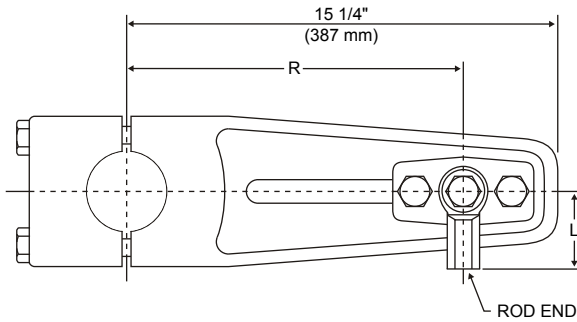
NOTE: All dimensions subject to change.

\*May vary per application. Refer to Valve Mounting Specification sheet shipped with your drive.

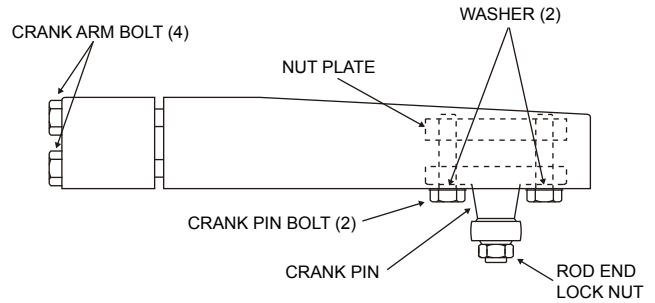
# MODEL 11-409 SPECIFICATIONS



## Crank Arm



ADJUSTABLE RADIUS "R" 6" (152 mm) TO 12" (305 mm)



## Model 11-409 Linkage Part Numbers & Model Information

### Recommended Bolt Torques

	Size (in.)	Torque	
		(lb-ft)	(N•m)
Crank Arm Bolts	5/8-18	170	230
Crank Pin Bolt	3/4-16	300	407
Rod End Lock Nut	3/4-16	120	163
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Cover Bolts	5/16-18	10	14
Motor Bolts	3/8-16	16	22
Gear Module Bolts	5/16-18	10	14

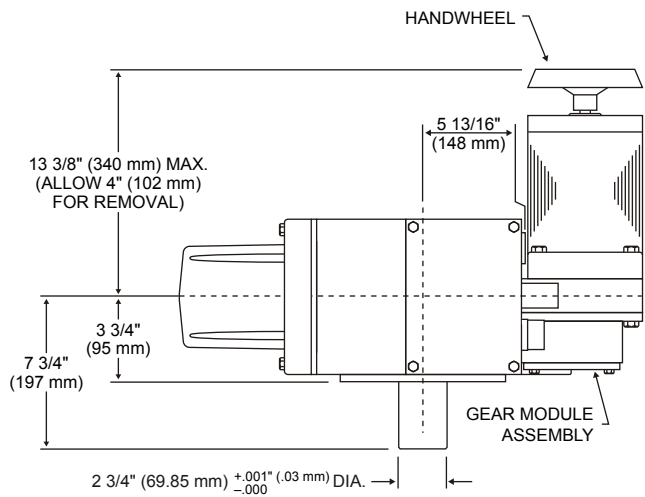
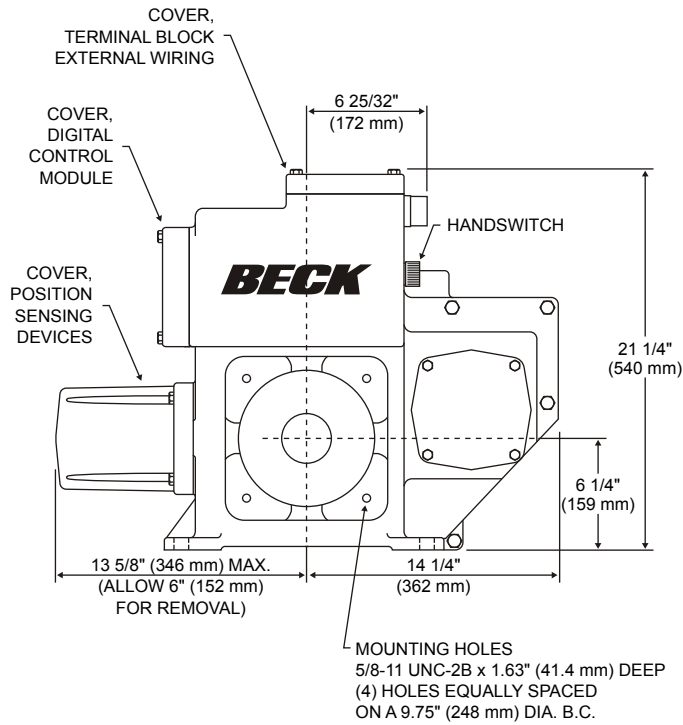
NOTE: All dimensions subject to change.

	11-409
Crank Arm Assembly	14-8018-02
Crank Arm	14-8018-01
Crank Arm Bolt (4)	30-0308-07
Washer (2)	30-0313-27
Crank Pin	14-9882-01
Crank Pin Nut Plate	20-2641-01
Crank Pin Bolt (2)	30-0308-03
Rod End Lock Nut	30-0309-24
Rod End	12-2840-04
Dim. "L" (Length)	2 7/8" (73 mm)
Dim. "T" (Thread)	3/4-16 x 1 3/4" (44 mm)
Output Shaft Dia.	2 3/4" (70 mm)
Approx. Weight	270 lbs (122 kgs)
Max. Overhung Load	9,000 lbs (4 082 kgs)



# OUTLINE DIMENSION DRAWINGS

## MODEL 11-469 SPECIFICATIONS

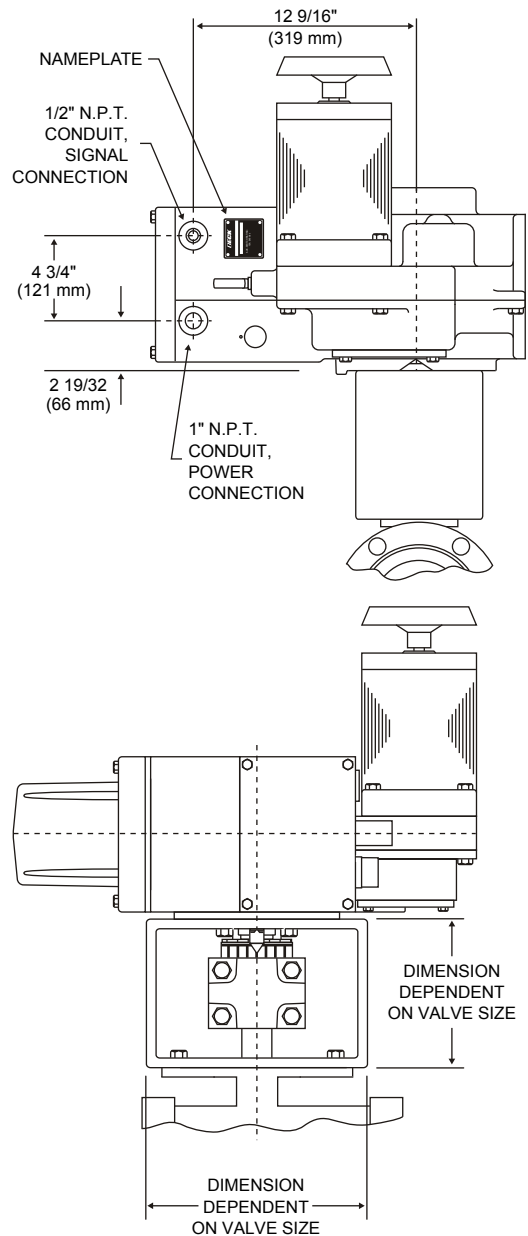


**BASIC CONTROL DRIVE**

### Model Information

Approximate Weight	216 lbs. (98 kg)
Maximum Overhung Load	9,000 lbs. (4 082 kg)

NOTE: All dimensions subject to change.



**TYPICAL VALVE MOUNTING**

### Recommended Bolt Torques

	Size (in.)	Torque	
		(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Gear Module Bolts	5/16-18	10	14
Motor Bolts	3/8-16	16	22
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	5/8-18	170*	230*
Mounting Bracket Bolts	5/8-11	100	135

\*May vary per application. Refer to Valve Mounting Specification sheet shipped with your drive.

# INSTALLATION

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## SAFETY PRECAUTIONS

### WARNING

**Installation and service instructions are for use by qualified personnel only. To avoid injury and electric shock, do not perform any servicing other than that contained in this manual.**

## STORAGE INFORMATION

The drive should be stored in its shipping carton in a clean, dry area.

If it is necessary to store the drive outdoors for a long period of time, it should be removed from its shipping carton and stored above ground. A waterproof cover should be securely fastened over it. Do not stack drives on top of one another. Stored drives should be periodically checked to make sure no condensation has formed in the control compartments. Damage due to moisture while in storage is not covered by warranty.

## UNPACKING

Beck drives are packed in standardized cardboard shipping containers. Drives mounted on valves are strapped to a skid and crated. After unpacking, the wooden platform may be used to transport the drive to the installation site.

# INSTALLATION

## INSTALLATION—MECHANICAL

Beck Group 11 drives may be installed in any convenient orientation, because the gearing does not require an oil bath. Refer to the outline dimension drawings on pages 8–14 for physical dimensions and required clearances.

### Installing a Drive with Linkage

When installing a Beck drive in a location remote from the damper or valve, be sure it is firmly bolted to a flat mounting surface that will not yield to the stresses created from operating the device. A rigid, vibration-free surface will generally prolong the life of the drive's components.

The output shaft of the drive should be parallel to the damper or valve shaft, and the linkage should be in a plane perpendicular to that of the two shafts. Small misalignments can be tolerated if a rod end fitting is used on the driven lever similar to that on the Beck crank arm. The drive's crank arm can be positioned at any angle on the shaft.

Beck drives can be furnished with valves mounted as unitized assemblies ready for pipeline installation. Beck linkage kits are available for convenient field installation (see page 5).

### Installing a Direct-coupled Drive

#### CAUTION

**Whenever a control drive is being mounted on a valve, it is good practice to remove the valve from service and observe these precautions:**

- Know what fluid is in the line.
- Wear proper protective equipment.
- Disconnect electrical power.
- Depressurize the pipeline.
- Refer to the valve maintenance manual for specific instructions.
- Consult the *Beck Valve Mounting Specification sheet* shipped with the drive for instructions.

### Installing a Unitized Valve/Drive Assembly on a Pipeline

Inspect the valve and pipe flanges to ensure they are clean. Be certain that other pipelines in the area are free from pipe scale or welding slag that could damage the gasket surfaces.

Carefully lift the assembly and position the valve in the pipeline. Install and tighten the flange bolts according to the valve and/or gasket manufacturer's instructions.

**NOTE: The valve may have undergone temperature variations in shipment. This could result in seepage past the stem seals. Refer to the valve manufacturer's maintenance instructions for packing adjustments.**

## INSTALLATION—ELECTRICAL

**NOTE: All Beck drives are shipped from the factory ready for installation; no electrical adjustments are required before placing them in operation. Each drive is set up and calibrated to the customer's specifications that were written into the equipment order.**

Two N.P.T. conduit connections are provided for power and signal wiring to the drive. The 1/2" conduit is provided for signal wiring connections, and the 1" conduit is provided for power and auxiliary switch connections. A sealant must be used on threaded conduit connections to keep moisture out. Conduits should be routed from below the drive so that condensation and other contaminants entering the conduit cannot enter the drive.

Power and signal wires must be routed to the drive separately and be either shielded cables or installed in conductive conduit and/or cable trays.

A large, clearly labeled terminal block on the top of the drive is enclosed in a separate, gasketed metal enclosure. Terminals will accommodate up to 12 AWG (3.31 mm<sup>2</sup>) wiring. See page 4 for location of the terminal block.

#### CAUTION

**Always close covers immediately after installation or service to prevent moisture or other foreign matter from entering the drive.**

Refer to the wiring diagram furnished with your Beck drive for proper AC power and signal connections. It is advisable to provide normal short circuit protection on the AC power line. A copy of the wiring diagram is shipped with each drive and is fastened to the inside of the terminal block cover. If there is no wiring diagram available, you may obtain a copy from Beck by providing the serial number of your drive.

Your Beck drive has been supplied to match the signal source in your control loop. If it does not match, a 250 ohm input resistor may be added or removed to obtain the proper match. Consult the factory for details.

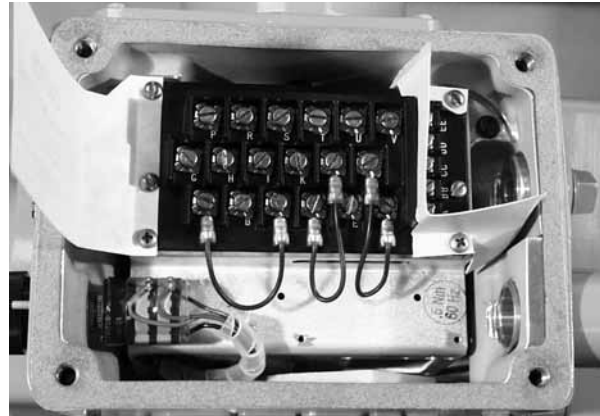
For maximum safety, the Beck drive body should be grounded. Use the grounding terminal in the wiring compartment of the drive.

# INSTALLATION *SIGNAL WIRING*

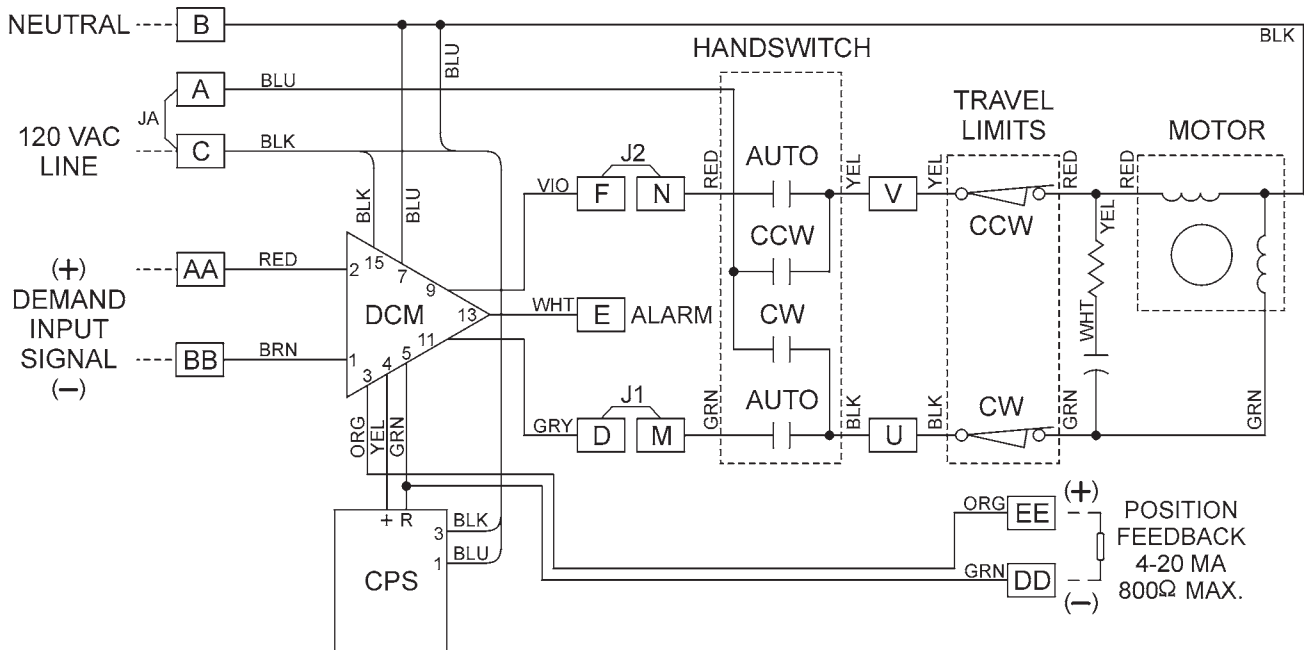
Each Beck drive is custom built to match the control requirements of your system specified at the time of order. Each drive has a specific wiring diagram attached to the inside of the wiring terminal cover. Typical wiring connections are described below.

A drive can be ordered with up to four optional auxiliary switches. Wiring connections for these are described on page 26.

To prevent Handswitch initiated motion, remove the jumper between terminals A and C. **CAUTION: AC power to the drive must be turned off before removing the jumper.**



## Typical Wiring Connections



### POWER AND DEMAND INPUT CONNECTIONS

Customer must supply 120 V ac to power the drive and control circuitry. 120 V ac line connects to terminal C and neutral to terminal B. Input signal wires connect to terminals AA (+) and BB (-).

# INSTALLATION *START-UP*

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## LINKAGE REQUIREMENTS (If Applicable)

In most applications, the best control will result when the linkage is adjusted so that the full 100° angular travel of the Beck drive output shaft is used, even though the valve or damper may travel less than 100°.

The general requirements for a good linkage are:

1. It must be rigid enough to carry the link thrust without bending or deforming.
2. It must have a built-in means of adjustment so that the length of the connecting link can be changed a small amount.
3. Rod end bearings, similar to those furnished on the Beck crank arm, should be used at both ends of the connecting link. This type of device permits small angular misalignments and helps prevent binding of the linkage.
4. The radius of the Beck crank arm must be calculated so that it will move the valve or damper lever through the correct arc as the lever travels from 0° to 100°.
5. The drive and valve / damper shafts must be parallel and the linkage should be in a plane perpendicular to the shafts.

The following procedure is recommended to couple the linkage between the Beck drive and the driven shaft (this procedure assumes that the Beck drive will open the damper/valve in response to an increasing signal) :

1. Position the driven shaft to the closed position.
2. Set the driven shaft lever to its predetermined starting angle in relation to the driven shaft and output shaft centerline.
3. Remove the rod end from the Beck crank arm. Attach to the connecting link.
4. Adjust the connecting link to the predetermined length.
5. Connect the connecting link to the driven lever at the predetermined radius.
6. Loosen the Beck crank arm clamping bolts.
7. Position the drive's output shaft to correspond with the driven shaft's fully closed position.
8. Set the crank pin on the Beck crank arm to the predetermined radius.
9. Swing the crank arm into position to assemble the rod end to the crank arm crank pin.
10. Tighten the crank arm clamp bolts to the torque recommended on pages 8, 10 and 13.
11. Tighten the coupling and rod end jam nuts.
12. Lubricate rod end bearings.

13. Carefully move the drive's output shaft to correspond with the driven shaft's fully open position. Check that no binding occurs between the linkage, crank arm, driven shaft lever, and surrounding obstructions. Also, observe that the driven shaft rotates the proper amount. Ensure that the drive reaches the proper limit and shuts off. If binding in the linkage occurs due to too much travel of the driven lever, reduce the crank arm radius on the Beck drive rather than adjusting the connecting link length. Return to step 5 and repeat adjustments.

To adjust the linkage length, alter the thread engagement in the couplings. The couplings have right- and left-hand threads, so it is not necessary to disconnect the ends to make a length adjustment. The stud threads must be engaged 1.2 diameters deep into the rod ends. Make adjustments by altering thread engagement in couplings only. Be careful not to expose more than 7" (178 mm) of stud between rod end and coupling.

Once again, check operation to determine that no binding occurs between linkage and crank arm or valve / damper lever arm. Surrounding objects must not interfere.

Do not change limit switch settings to obtain desired valve or damper travel. This shortens the travel of the feedback device and reduces the control resolution, repeatability, accuracy of the drive, and available torque.

For an input control signal change, do not adjust the linkage. Refer to the Calibration section of this manual.

## Link-Assist™

The Beck Link-Assist™ computer program optimizes the linkage configuration for your load's torque characteristics to help you select the minimum drive size for your application. Contact your Beck Sales Engineer to take advantage of Beck's Link-Assist™ program.

## Linkage Kits Available

Standard Beck linkage kits are made to accommodate a wide variation in linkage lengths without requiring modification of end fittings. This adaptability makes it possible to order the essential linkage end connections even though the exact linkage length may not be known until the valve / damper and drive are mounted in place.

Each linkage kit includes the essential pipe linkage end connections, rod end, and all necessary hardware. Schedule 40 pipe is not included and must be cut to length and threaded





# OPERATION

## HOUSING

Beck electronic control drives have individual cast aluminum compartments for each of the five main components: The control motor, wiring terminal block, drive train, digital control module, and control end. Gasketed covers and sealed shafts make the drives ideally suited to outdoor and high humidity environments.

Heavy cast mechanical stops built into the housing are designed to prevent accidental over-travel damage during manual cycling, and ensure that proper orientation is maintained between the output shaft and the feedback system. Drive travel is centered between the mechanical stops unless otherwise specified at time of order.

## CONTROL MOTOR

The Beck control motor is a synchronous inductor motor which operates at a constant speed of 72 RPM or 120 RPM in synchronism with the line frequency.

Motors are able to reach full speed within 25 milliseconds and stop within 20 milliseconds; actual starting and stopping times will vary with load.

Beck motors have double grease-sealed bearings and require no maintenance for the life of the motor.

## GEAR TRAIN

The gear train is a four-stage reduction, spur gear drive constructed with only heat-treated alloy steel and ductile iron gears for durability and long life.

The drive train consists of the control motor and Handwheel, reduction gears, main gear, output shaft, and crank arm. The main gear / output shaft and third stage gears are common to all units of a particular drive model. The second and first stage gears are part of the field-interchangeable gear module. Different combinations of gear modules and drive motors determine the drive's output torque and timing. See Table 9, page 83 for details.

On all models except the 11-169, the output shaft is limited by mechanical stops to 108° of rotation. On model 11-169 drives, the output shaft is limited by mechanical stops to 98° of rotation. Optional main gear / output shaft assemblies are available that permit multi-revolution output rotation. Mechanical stops are not included on these models. Mechanical transmission of output shaft position to the control end is provided by a right angle gear set driven directly by the output shaft.

## SELF-LOCKING MECHANISM (SLM)

An integral part of every control motor is the self-locking mechanism. This mechanical device couples the motor to the gear train and transmits full motor torque when rotated in either direction. When the motor is de-energized, the SLM instantaneously locks and holds the output shaft in position.

## HANDWHEEL

Every Beck control drive is furnished with a Handwheel to permit manual operation of the valve or damper without electrical power. Its solid construction design includes no spokes or projections, and turns at a safe, slow speed. The Handwheel is located at the rear of the control motor housing. The Handwheel is coupled directly to the motor shaft and rotates when the motor runs. Manual operation of the Handwheel (with electric Handswitch in "STOP" position) turns the motor and the rest of the drive train without incorporating a clutch.

## HANDSWITCH

A local electric Handswitch is provided on Beck drives to permit operation at the valve or damper, independent of the controller. As a safety feature, the Handswitch is designed so that the controller can operate the drive only when it is in the "AUTO" position. The sequence of the Handswitch is: "AUTO", "STOP", "CW", "STOP", "CCW". When the Handswitch is turned fully clockwise, "AUTO" should be indicated.

In the "AUTO" position, two contacts are closed and the DCM-2 completes the control circuit.

In the "CW" or "CCW" positions, contacts are closed to operate the drive independently of the controller.

In the "STOP" position, all contacts remain open.

To prevent Handswitch initiated motion, remove the jumper between terminals A and C. **CAUTION: AC power to the drive must be turned off before removing the jumper.**

## SWITCHES

Two over-travel limit switches and up to four optional auxiliary switches are provided on Beck drives. Switch cams are clamped onto the control shaft which rotates in relation to the output shaft. Cam position is field-adjustable. Switches are rated 6 A, 120 V ac. All auxiliary switch connections are made on the terminal block.

## **LOSS OF DEMAND INPUT SIGNAL (L.O.S.)**

When the Demand input signal drops to approximately -5%, the DCM-2 considers the Demand input signal to be invalid. DCM-2s are typically configured to stop the drive during L.O.S. conditions, but may be configured by the factory or by using the HART or Serial interface to run the drive to a predetermined position. Under the L.O.S. condition, the "STAT" and "DEMAND" LEDs will light. When the input signal is corrected, the drive will automatically resume normal operation. The value for LOS activation is configurable using the HART (see page 47) or Serial interface (see page 70). Alarm indication is available at terminal E.

## **POSITION: CONTACTLESS POSITION SENSOR (CPS)**

The CPS provides the DCM-2 with a continuous feedback signal proportional to the position of the drive's output shaft.

The position sensing function of the CPS is provided by a ferrite magnetic sensing element. An electronic circuit translates the signal from the ferrite magnetic sensor into a position signal used by the DCM-2 to control the drive. The typical output voltage of the CPS ranges from 1.0 V at the CCW end of travel, to 5.0 V at the CW end of travel. A 4–20 mA position feedback signal is available for remote position indication (see page 17). If the CPS Position signal to the DCM-2 is out of the calibrated range limits, the "STAT" and "POSITION" LEDs will light and the drive will not operate until the limits are adjusted or the CPS is corrected. Alarm indication is available at terminal E.

## **TORQUE PROTECTION (FOR DRIVES EQUIPPED WITH THIS OPTION)**

DCM-2s are equipped with a torque sensing module that will light the "STAT" and "TRQ/THRUST" LEDs in the event excessive torque is detected. This alarm is normally set to activate when torque exceeds 105% of the drive rating. Torques above 150% of the drive rating will cause the DCM-2 to stop trying to run in the direction of the high torque. When the over torque condition is corrected, the drive will automatically resume normal operation. The torque sensing module also provides a number of torque related features using the HART interface (see page 48). Torque alarm may be enabled or disabled using the

HART (see page 48) or Serial interface (see page 71). Torque alarm levels may be adjusted using the HART or Serial interfaces. Alarm indication is available at terminal E.

## **STALL PROTECTION AND ANNUNCIATION**

If the drive output shaft cannot reach a desired position within approximately 300 seconds, the DCM-2 shuts off power to the motor and the "STAT" and "STALL" LEDs will light. The stall condition timing is factory configurable (or configurable using the HART or Serial interface) from 300 seconds to as low as 30 seconds and is initially set according to the specification at time of order.

A sensed stall condition is cleared by either reversing the Demand input signal from the controller (such that the drive tries to run in the direction opposite the blocked direction), performing a "Reset Stall" or "Board Reset" using the HART interface (see page 42), or by switching the drive power off and on. Alarm indication is available at terminal E.

## **TEMPERATURE**

DCM-2s are equipped with a temperature sensing circuit. The "STAT" and "TEMP °F" LEDs will light when the drive's ambient temperature exceeds the rating of the drive. Specific temperature readings are available using the HART (see page 40) or Serial (see page 72) interface. Alarm indication is available at terminal E.

## **FEEDBACK SIGNAL**

The feedback sourcing module provides a 4–20 mA analog output signal that represents the drive output shaft position in terms of 0–100% of full rotational travel (configurable via the HART (see page 56) or Serial (see page 75) interface). This signal can be remotely monitored or used by a controller or indicator. The "STAT" and "FB OPEN" LEDs will light if the function is enabled and there is no current in the loop. The Feedback signal can be factory configured as disabled, or disabled using the HART (see page 46) or Serial (see page 71) interface. Alarm indication is available at terminal E.

## **STOP/LIMIT INDICATION**

The "STAT" and "STOP/LIMIT" LEDs will light if the Handswitch is in the "STOP" position. These LEDs will also light if the drive is at a limit and is not in balance. Alarm indication is available at terminal E.

# DIGITAL CONTROL MODULE (DCM-2)

## INPUT: DIGITAL CONTROL MODULE (DCM-2)

Beck modulating drives are equipped with a precision, digital control module (DCM-2) designed to receive conventional 4–20 mA or 1–5 V dc control signals directly—eliminating the need for contact protection devices, relays, switches and reversing starters.

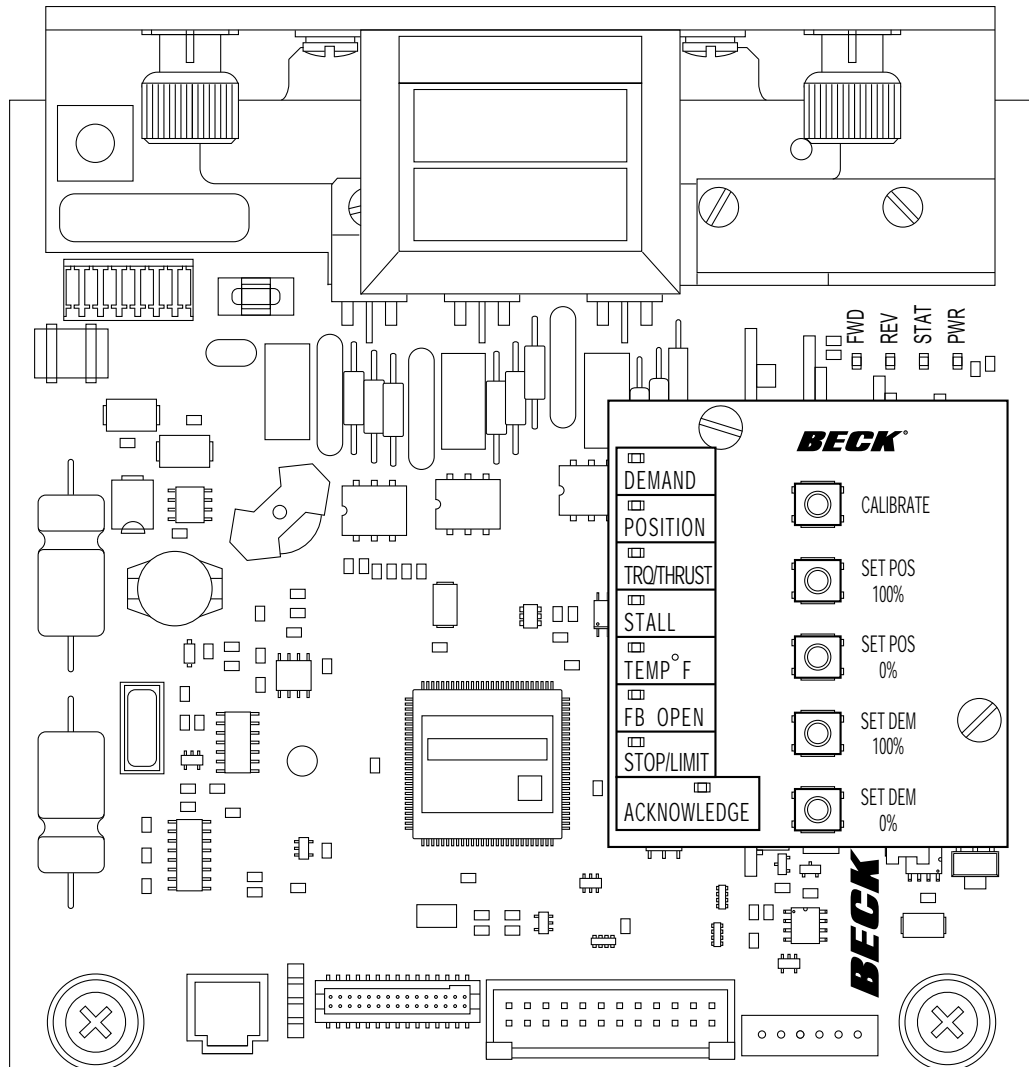
The DCM-2 modulates the drive output shaft in response to an analog Demand input signal and is designed to operate continuously in temperatures up to 185°F (85°C).

The DCM-2 provides intelligent calibration, easy drive setup changes, and diagnostic information. A **Local interface** provides quick

pushbutton setup and diagnostics without the need for a handheld or remote device (see page 23). A **HART communications interface** allows remote access of all features and information (see page 36). A **Serial interface** also allows for drive configuration changes, drive information reporting and to assist in troubleshooting (see page 66).

The DCM-2 permits two or more Beck drives to be operated by a single signal source. See pages 29 and 57 for details on split range operation.

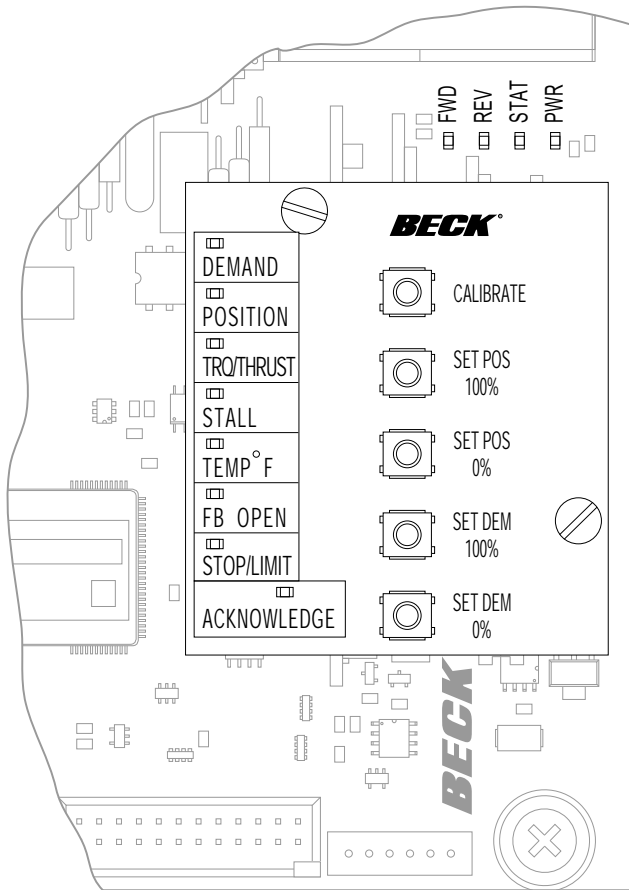
A square function is available to position the drive's output shaft proportionally to the square of the input signal. This function is factory configurable (specify at time of order) or may be configured using the HART interface (see page 46) or Serial interface (see page 70).



# DCM-2 LOCAL INTERFACE *Operation*

## OVERVIEW

The DCM-2 customer interface panel (pictured below) allows the user to easily calibrate the drive and troubleshoot conditions. The following information provides an overview of the DCM-2 customer interface panel features.



**NOTE: Beck drives are shipped from the factory set up and calibrated to customer specifications placed at the time of order and are ready for installation.**

## Overview LEDs

The four LEDs, as highlighted below, indicate the present state of the drive.

### FWD

This LED is lit when the drive is receiving a Demand signal greater than its position.

### REV

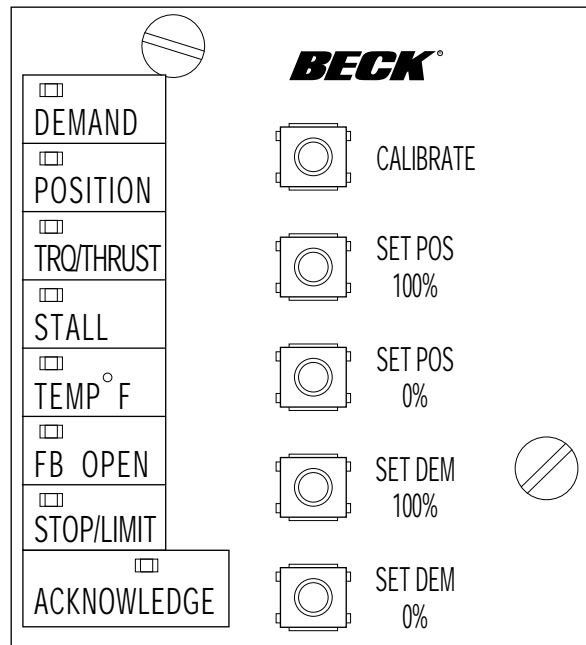
This LED is lit when the drive is receiving a Demand signal smaller than its position.

### STAT

This LED is lit when additional status is available. For details regarding possible conditions, see "Status Indication LEDs" on page 24.

### PWR

This LED is lit when power is applied to the drive. This LED pulses from bright to dim indicating the DCM-2 is fully operational.





# DCM-2 LOCAL INTERFACE *Operation*

## Status Indication LEDs

When the “STAT” LED is lit, the applicable status indication LED(s) (pictured below) will light to reveal the condition(s) as described below. An alarm is also available at terminal E. When the condition is corrected, the status will automatically reset. Each status LED is described below, with a more detailed explanation of the function provided on page 21.

### DEMAND

Loss of the Demand input signal.

### POSITION

The CPS Position signal to the DCM-2 is out of the calibrated range limits. The lower limit is -5% and the upper limit is 105% of the calibrated range. This LED may also indicate a CPS or internal wiring failure.

### TRQ/THRUST

This LED indicates that excessive torque is present (over 105% of the drive rating). This LED is functional only when the drive is equipped with optional torque sensing.

### STALL

The drive is in a stall condition and stall protection has been activated.

### TEMP °F

Drive’s internal temperature is outside of rating.

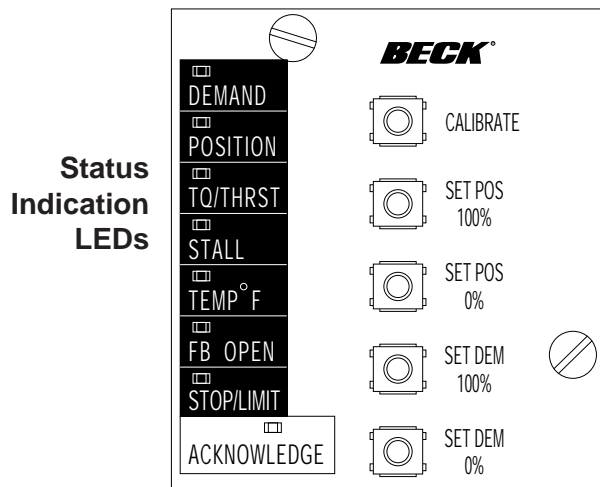
### FB OPEN

External position Feedback signal is enabled, but not wired to an external load or the wiring has failed between the drive and the monitoring device.

### STOP/LIMIT

Handswitch is in “STOP” position or the drive is at a limit and is not in balance.

FWD  
REV  
STAT  
PWR



## Pushbutton Controls

The five pushbuttons (pictured below) on the DCM-2 customer interface panel are used for calibration. When pressing a pushbutton, pressure should be maintained until the “ACKNOWLEDGE” LED lights; this confirms receipt of the pushbutton command. See the Calibration section, beginning on page 25, for further explanation of the calibration procedures. Pushbutton functions are as follows:

### CALIBRATE

A safety feature, this button must be pressed and held while pressing the pushbuttons described below to set the Position and Demand signal limits.

### CAUTION

**Pressing the following buttons may change calibration and cause the drive to reposition.**

### SET POS 100%

Press to set the desired 100% position for drive movement (this will correspond to a 100% Demand signal).

### SET POS 0%

Press to set the desired 0% position for drive movement (this will correspond to a 0% Demand signal).

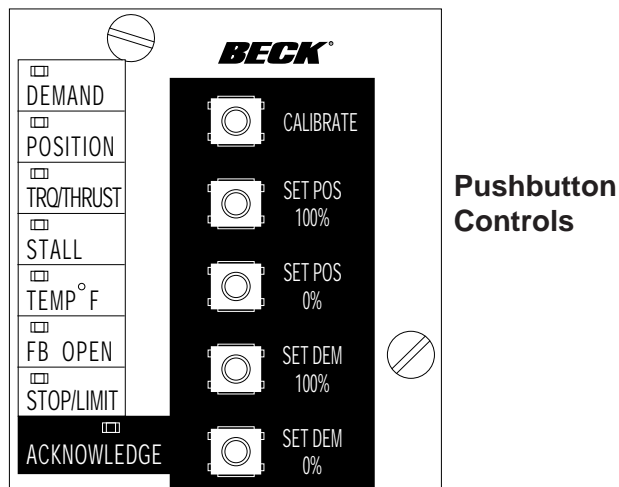
### SET DEM 100%

Press to set the Demand input signal that corresponds to 100% Demand.

### SET DEM 0%

Press to set the Demand input signal that corresponds to 0% Demand.

FWD  
REV  
STAT  
PWR



# DCM-2 LOCAL INTERFACE *Calibration*

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All Beck drives are shipped completely calibrated to the customer's specifications that were written into the equipment order and are ready to be installed. If the need arises to change the drive calibration, first confirm that the drive is installed as specified and operating properly before proceeding with the change.

Position reference and demand calibration are performed using the DCM-2 customer interface panel, but may also be configured using the HART or Serial interface. Calibration of over-travel limit and auxiliary switches must be performed using the procedure beginning on page 26.

## **CALIBRATION PRIORITY**

### **Models 11-159, -209, -309 & -409**

Standard Group 11 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft rotation must occur within these stops, which are approximately 108° apart.

The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart than the drive's intended full range of electronic operation (typically 100°). The limit switches are positioned to provide an electrical overtravel protection (typically 101°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 100° rotation (see page 30)—it may be desirable to reset the over-travel limit switches (see page 26). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. It is best to calibrate the drive and then set the limit switches when short-stroking the drive. The switches should be set just outside the calibrated range to avoid tripping the switch at the 0% and 100% positions.

The auxiliary switches are also cam operated, but have no affect on drive and DCM-2 operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.

### **Models 11-169, -269, -369 & -469**

Standard Group 11 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft rotation must occur within these stops, which are approximately 108° apart; except for the 11-169 stops, which are 98° apart.

The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart than the drive's intended full range of electronic operation (typically 90°). The limit switches are positioned to provide an electrical overtravel protection (typically 91°).

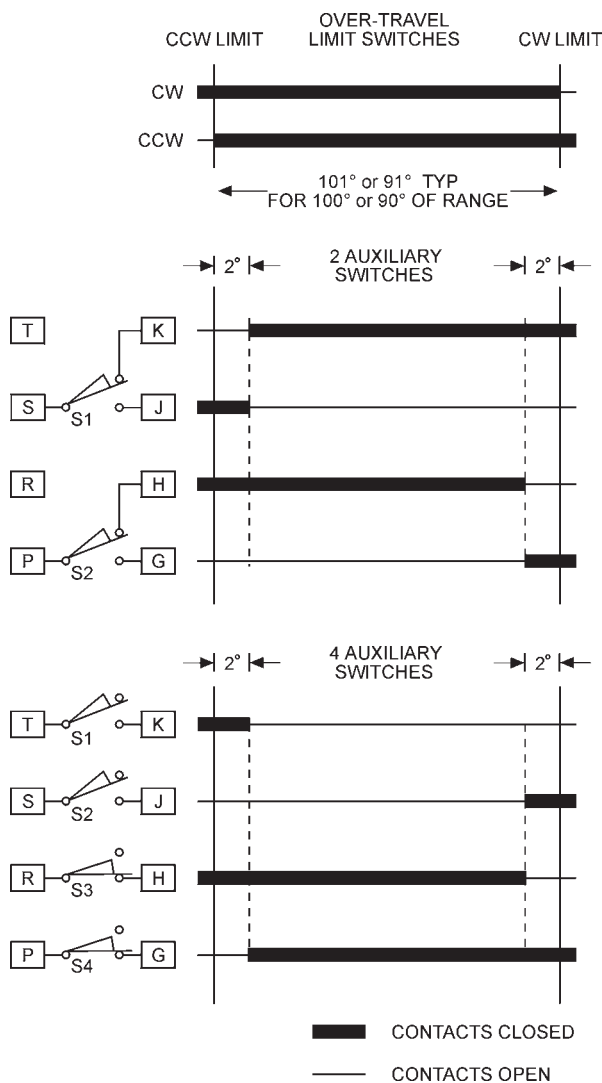
If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 90° rotation (see page 30)—it may be desirable to reset the over-travel limit switches (see page 26). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. Because the over-travel limit switches define the maximum electrical drive range, if they are to be reset, they should be adjusted before performing DCM-2 (demand and position) calibration procedures.

The auxiliary switches are also cam operated, but have no affect on drive and DCM-2 operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.

# DCM-2 LOCAL INTERFACE *Calibration - Switches*

**NOTE: Your Beck drive was shipped from the factory ready for installation; no electrical adjustments are required before placing it in operation. Each drive is set up and calibrated to the specifications that were written into the equipment order.**

Under normal operating conditions there is no need to recalibrate the control drive. However, if the application requirements change or are different than specified on the equipment order, the drive should be recalibrated according to the following procedures.



**Standard Over-travel Limit and Auxiliary Switch Settings**

## SWITCH ADJUSTMENTS

Control drives are shipped with over-travel limit switches factory-set for either 101° (11-159, -209, -309, -409) or 91° (11-169, -269, -369, -469) of travel unless otherwise specified at time of order. Limit switches must be set inside the range of the built-in, non-adjustable mechanical stops to prevent stalling of the motor. Limit switches can be reset to limit travel of the output shaft to any angle down to a minimum of 60°. Auxiliary switches are set as shown in the figure at left unless otherwise specified at time of order.

**NOTE: The over-travel limit switches are the switches closest to the drive body. To adjust the over-travel limit switches, it is necessary to remove the control end cover.**

Switches are operated by cams which are clamped onto the control shaft. Setting a switch involves loosening the cam, moving the output shaft to the desired position, and positioning the cam so that it just operates the switch at that point. In the following procedure, the use of a continuity meter is recommended to determine when the switch opens or closes. If such a meter is not available, it is possible to hear the switch click as the contacts open and close.

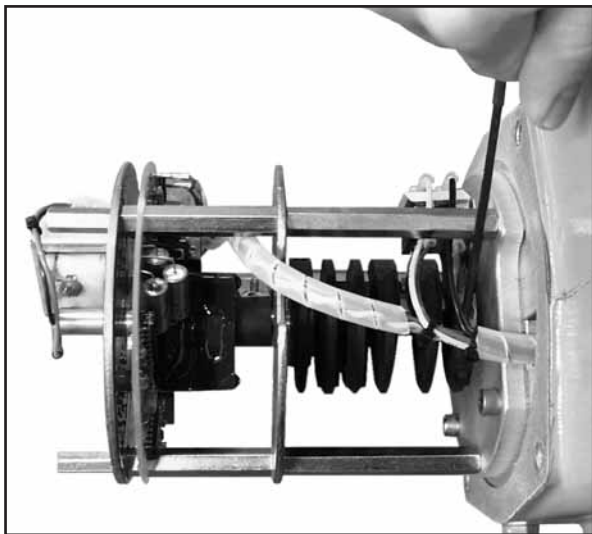
### CAUTION

**Do not attach the meter or attempt to move the switch cams until the drive is disconnected from the line voltage and auxiliary switches are disconnected from external power sources.**

## Setting Over-travel Limit Switches CW and CCW

This procedure should be used if the factory over-travel limit switch settings must be changed in the field. It is advisable to operate the drive fully in each direction, using the electric Handswitch to check switch settings before attempting to change them. Follow these instructions if they require adjustment:

1. Remove the control end cover and terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the control shaft so that the CW switch cam screw is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft (see illustration below).
3. Move the output shaft clockwise to the desired CW limit.
4. Turn the Handswitch to the "STOP" position.
5. **Disconnect power from the drive.**
6. Turn the Handswitch to the "AUTO" position.
7. Connect the continuity meter across terminals B and M. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
8. Tighten the cam locking screw to 5 lb-in (.56 N•m) torque.
9. Disconnect meter and turn the Handswitch to the "STOP" position.
10. Reconnect drive power.
11. Rotate the drive's output shaft in the CCW direction away from the CW travel limit. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever with the switch lever on the lower part of the cam. If not correct, return to step 2 and reset the cam to the proper orientation.
12. Rotate the output shaft again to the desired CW travel limit. If the stopping point is reached, the switch is properly set.



**Loosening Switch Cam**

13. Repeat instructions for setting CCW travel limit switch (noting that referenced directions of rotation should be opposite of those used for CW switch setting). Connect continuity meter across terminals B and N.
14. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.
15. Rotate index (or index pointer on models 11-159 or -169) to correspond with output shaft rotation.

## Setting Auxiliary Switches

Standard switch settings for drives with 2 or 4 auxiliary switches are shown on the diagram on page 26. The heavy line indicates a closed circuit. Follow these instructions to change the operating point of auxiliary switches:

**NOTE: In the following procedure, it is assumed that switch settings are to be adjusted so that contacts are open when the desired position is achieved. If they are to be adjusted to close, it may be necessary to reverse the operating mode of the switch by moving the wire lead to the other terminal on the switch itself. Be sure to disconnect power from the switch terminals first.**

1. Remove the control end cover and the terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the shaft so that the switch cam is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft.
3. Move the output shaft to the desired position.
4. Turn the Handswitch to the "STOP" position.
5. Disconnect power from the drive and switch terminals.
6. Connect the continuity meter across the appropriate terminals. See the diagram on page 26 or the drive wiring diagram. Rotate the cam to operate the switch.
7. Tighten the cam locking screw to 5 lb-in (.56 N•m) torque.
8. Disconnect the meter and reconnect power.
9. Move the drive's output shaft in the desired direction to verify that the cam lobe moves away from the switch lever. If not correct, return to step 2 and reset the cam to the proper orientation.
10. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.

## DEMAND CALIBRATION

DCM-2 boards are designed to accept a 4–20 mA (or 1–5 V dc) analog demand signal. Narrower spans within this range can also be accommodated for split range operation (see page 29). The input comes calibrated from the factory for the full range unless otherwise specified by the customer. It is not necessary to calibrate the Demand input when the drive is installed; however, it can be easily accomplished using the DCM-2 pushbutton controls (or HART or Serial interface) and a signal source. Following this procedure is only necessary to compensate for slight differences between the signal source calibration and the DCM-2 factory calibration, or if reduced range calibration is desired for special operating scenarios such as split ranging.

## Calibration Procedure

1. Remove the DCM-2 cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive (e.g., 4 mA for 4–20 mA input). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 17.
4. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*
5. Apply the desired 100% Demand input signal to the drive (e.g., 20 mA for 4–20 mA input).
6. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*
7. Turn the Handswitch to the "AUTO" position.  
NOTE: The drive may reposition.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the compartment covers and tighten the cover bolts to 10 lb-ft (14 N•m) torque.

\* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM-2. This is typically caused by trying to set 0% and 100% values too close together (i.e., less than 4 mA difference).



## Split Range Operation

It is sometimes desirable or necessary to have more than one final control element controlling a single process. Often, this type of control strategy requires that two to four Beck drives each respond to different portions of one 4–20 mA Demand signal from the control system.

This type of operation is called split range operation. For example, consider the most common split range scenario—two drives split ranged for 50% of the 4–20 mA Demand signal input. Both drives are wired in parallel to receive the same 4–20 mA signal (note that the 250 Ohm R11 resistor (see DCM-2 illustration on page 78) must be removed from one of the two drive DCM-2 boards to allow HART® communications. If more than two drives are split ranged, the R11 resistor must be removed from all the DCM-2 boards but one), but each drive’s interpretation of the signal must be different. One drive must interpret 4–12 mA as 0–100% Demand, and one drive must interpret 12–20 mA as 0–100% Demand. This requires that the drives have different Demand signal calibrations.

To set up a split range operation, follow the steps listed below (see page 24 for location of pushbutton controls).

**NOTE: Ensure that the L.O.S. (Loss of Demand input signal) settings of the drives are appropriate for the configuration. See page 21 for information on changing L.O.S. settings.**

1. Remove the DCM-2 cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive. (Following the example above, the minimum signal for the first drive would be 4 mA. The second drive’s minimum signal would be 12 mA). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 17.
4. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*
5. Apply the desired 100% Demand input signal to the drive. (Following the example above, the maximum signal for the first drive would be 12 mA. The second drive’s maximum signal would be 20 mA).

6. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*
7. Repeat this process for the remaining drives to be split-ranged.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the DCM-2 cover. Tighten the cover bolts to 10 lb-ft (14 N•m) torque.

\* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM-2. This is typically caused by trying to set 0% and 100% values too close together (i.e., less than 4 mA difference).

## Square Function

Beck drives can be set up to position the output shaft proportionally to the square of the Demand input signal (see table below). This function is factory configurable, or may be configured using the HART or Serial interface.

Demand Input Signal (mA)	Standard Output (% of Span)	Square Function Actual Output Position (% of Span)
4.0	0	0
5.6	10	1
12.0	50	25
15.2	70	49
18.4	90	81
20.0	100	100



# DCM-2 LOCAL INTERFACE *Calibration - Position*

## POSITION CALIBRATION

In order to correctly position the drive output shaft in response to the Demand input signal, the DCM-2 receives a position signal from the drive's position sensor and compares this actual position to the Demand input. This process requires that the DCM-2 interprets the position signal appropriately for the full range of desired travel. This procedure will calibrate the DCM-2 to accept the position signal and interpret the appropriate 0–100% range. Note that all drives come factory calibrated and there is no need to recalibrate unless changes in operation are desired.

It is also possible to calibrate the position signal using the HART or Serial interface.

## Calibration Procedure

**NOTE: Prior to adjusting the travel range electronically (using the DCM-2), it is recommended that the over-travel protection switches be reset just outside the intended travel range (see page 26).**

1. Remove the DCM-2 cover (1/2" bolt heads).
2. Position the drive at the desired minimum position (i.e., the desired physical position of the drive's output shaft corresponding to the 0% Demand input signal).
3. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
4. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET POS 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*
5. Position the drive at the desired maximum position (i.e., the desired physical position of the drive's output shaft corresponding to the 100% Demand input signal).
6. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
7. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET POS 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*
8. Optional: Adjust the over-travel limit switches (see page 26) just outside the 0% and 100% limits.
9. Verify that the drive's 0% and 100% positions are correct. If not, repeat this procedure.
10. Replace the compartment cover and tighten the cover bolts to 10 lb-ft (14 N•m) torque.

\* If the "ACKNOWLEDGE" LED does not light, but the "POSITION" LED does light, the signal is out of acceptable range and was not accepted by the DCM-2.

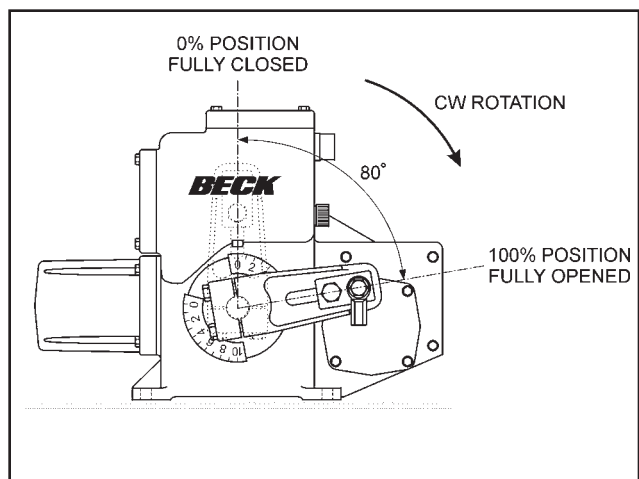
## Short-stroke Operation (Reducing Full Rotation)

Typically, it is best to use the full 100° (or 90° for quarter-turn valve drives) rotation of the drive in response to the 0–100% Demand input signal—this allows full flexibility in arranging the drive's torque to be distributed for the best mechanical advantage relative to the driven load.

In certain applications, as a last resort, it may become necessary to reduce the full rotation of the drive. In these applications, the DCM-2 can be calibrated to accommodate reduced stroke. The recommended *minimum* full stroke rotation is 60° (although it is advisable to make the range as close to 100° (or 90°) as possible for the highest position resolution attainable with the CPS and to avoid reduction in torque (linkage connected drives); if the driven element stroke rotation is less than 100° (where applicable), a linkage can be used to allow the driven element to move the correct rotation while still allowing the drive to rotate 100°).

To reduce the full rotation of the drive (short-stroke), use the customer interface panel and follow the "position calibration" instructions (this page). Short-stroking can also be accomplished by using the HART (see page 55) or Serial (see page 71) interface.

The illustration below represents a Beck drive with linkage requiring an 80° full stroke rotation. (Please note that the crank arm may be adjusted to any start angle orientation).

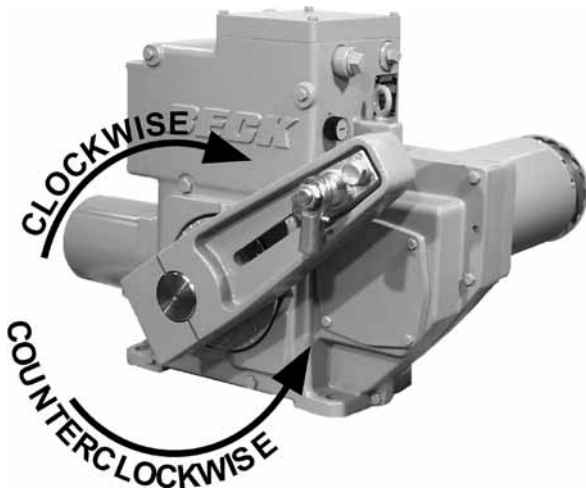


NOTE: Crank arm may be adjusted to any start angle orientation. The orientation shown above has been randomly selected for the purpose of this example.

# DCM-2 LOCAL INTERFACE *Calibration - Direction Change*

## DIRECTION OF OUTPUT SHAFT ROTATION (CW vs. CCW)

Direction of output shaft rotation is determined by observing the end of the output shaft (see illustrations below). Direction of rotation is defined as the direction of output shaft rotation produced by an increasing Demand signal. Unless otherwise specified at the time of order, the output shaft is factory set to rotate clockwise in response to an increasing signal.



Changing the direction of output shaft rotation is easily accomplished using the DCM-2 customer interface panel (see page 23 for location of pushbutton controls) or the HART or Serial interface. Follow the steps below.

1. Remove the DCM-2 cover (1/2" bolt heads).
2. Position the drive at the present 0% position.
3. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET POS 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*

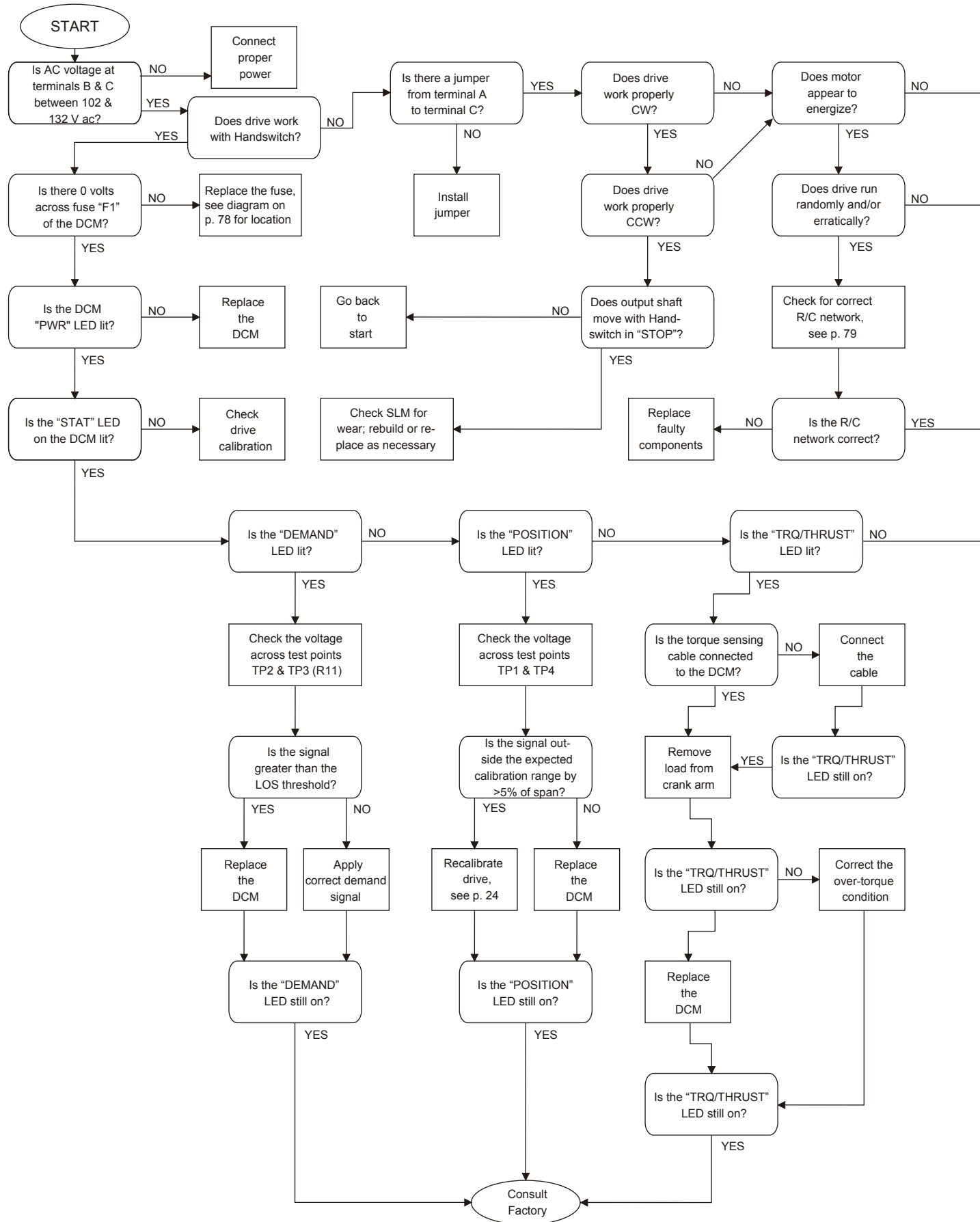
—OR—

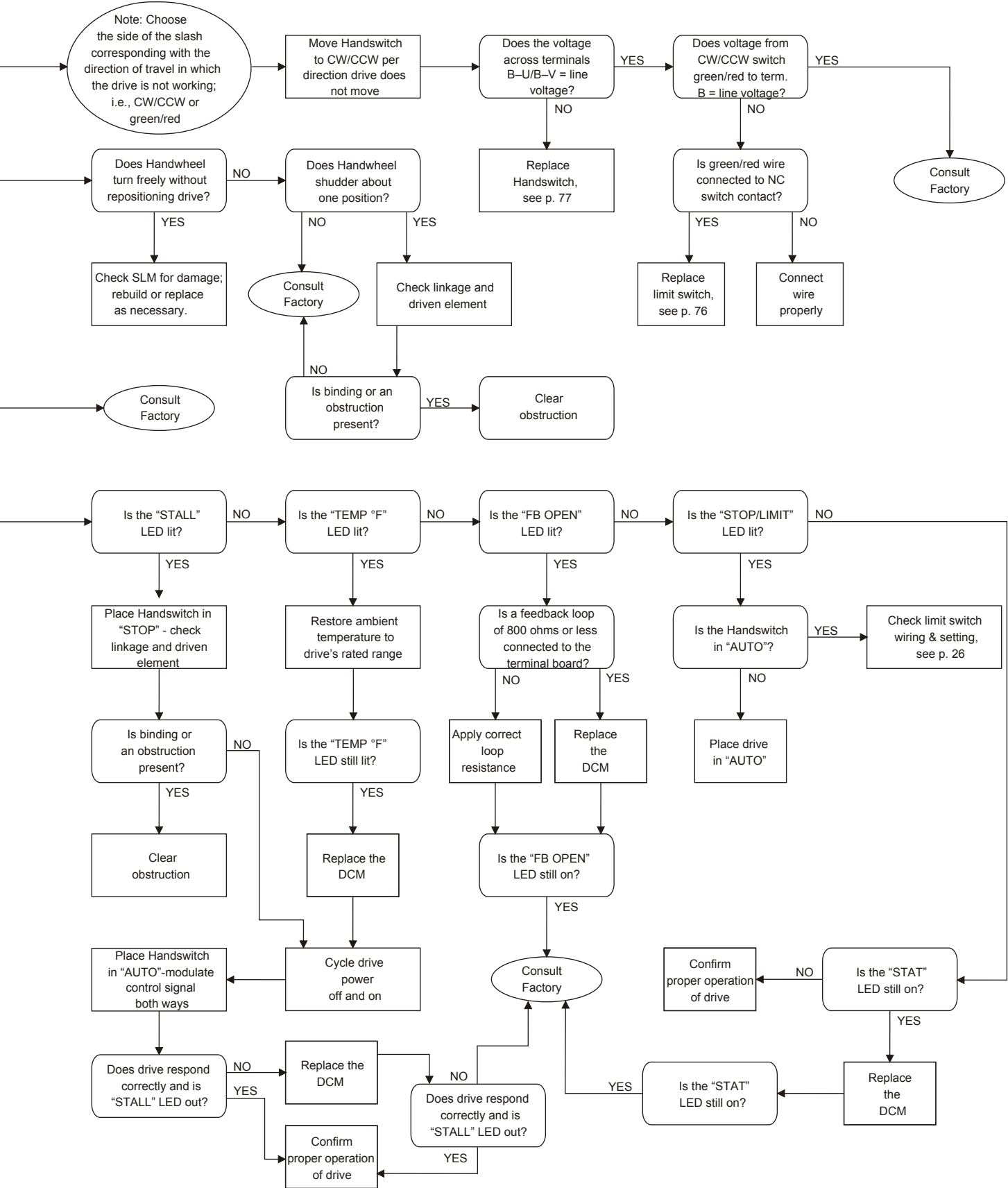
2. Position the drive at the present 100% position.
3. Press and hold the "CALIBRATE" pushbutton on the DCM-2 customer interface panel, then press the "SET POS 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.\*
4. Ensure the drive operates as desired.
5. Replace the DCM-2 cover and tighten the cover bolts to 10 lb-ft (14 N•m) torque. Reset travel index.

\* If the "ACKNOWLEDGE" LED does not light, but the "POSITION" LED does light, the signal is out of acceptable range and was not accepted by the DCM-2.

NOTE: When either of the above procedures is performed, both the 0% and 100% positions are automatically set.

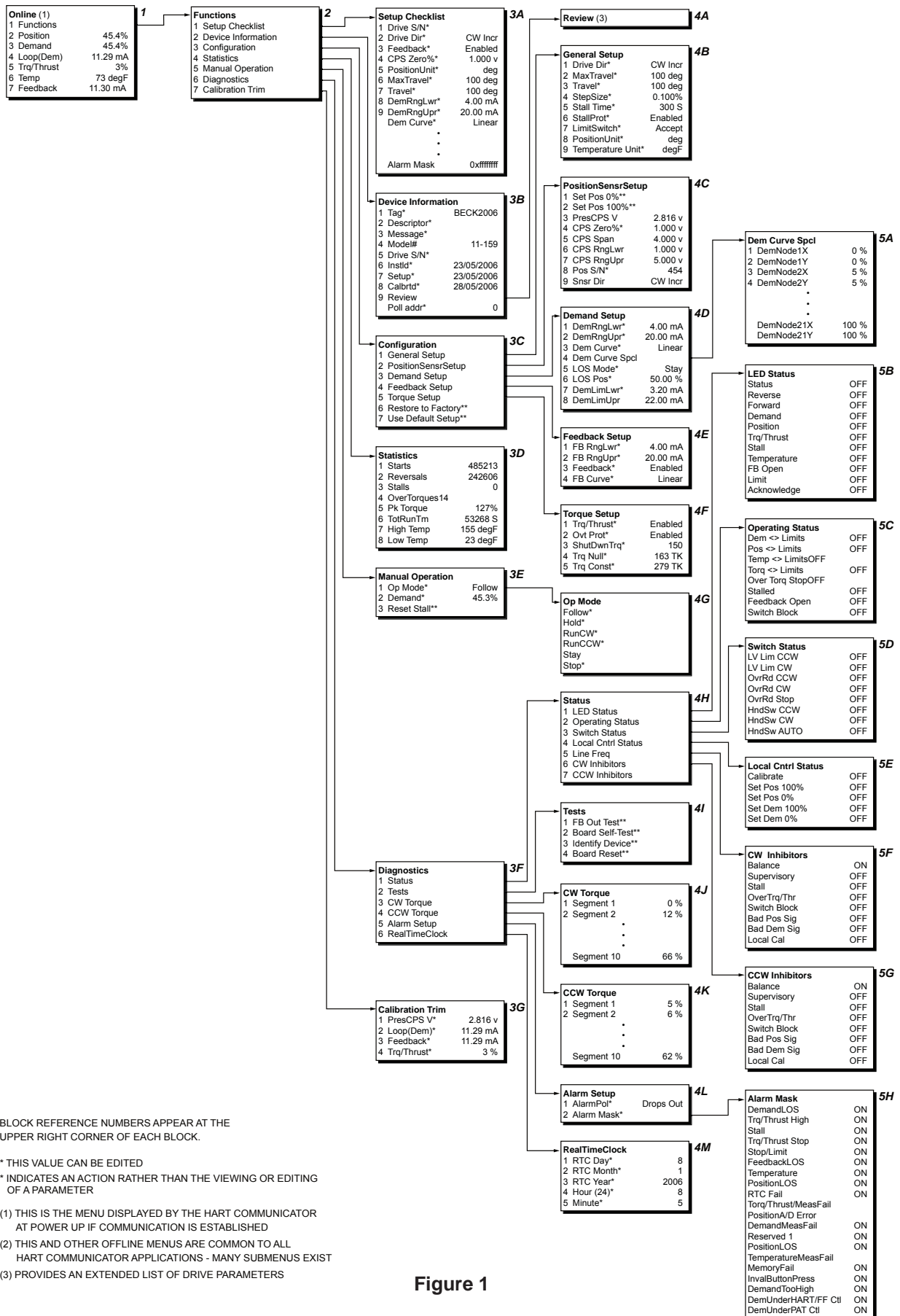
# DCM-2 LOCAL INTERFACE *Troubleshooting*





# DCM-2 HART INTERFACE *Communication*

## BECK-MK2 HART COMMUNICATOR MENUS FOR THE DCM-2



BLOCK REFERENCE NUMBERS APPEAR AT THE UPPER RIGHT CORNER OF EACH BLOCK.

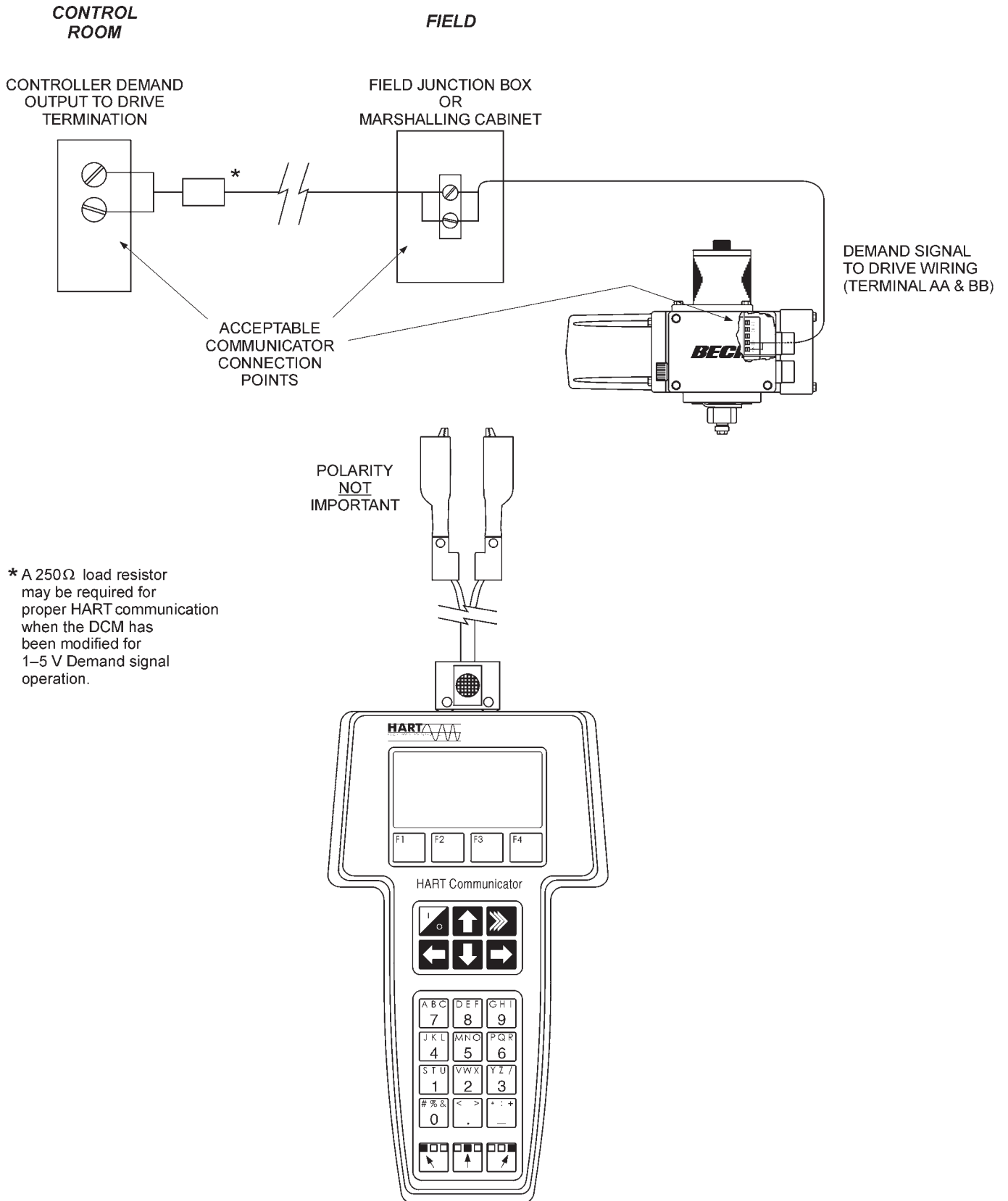
\* THIS VALUE CAN BE EDITED

\*\* INDICATES AN ACTION RATHER THAN THE VIEWING OR EDITING OF A PARAMETER

- (1) THIS IS THE MENU DISPLAYED BY THE HART COMMUNICATOR AT POWER UP IF COMMUNICATION IS ESTABLISHED
- (2) THIS AND OTHER OFFLINE MENUS ARE COMMON TO ALL HART COMMUNICATOR APPLICATIONS - MANY SUBMENUS EXIST
- (3) PROVIDES AN EXTENDED LIST OF DRIVE PARAMETERS

Figure 1

## HANDHELD COMMUNICATOR WIRING CONNECTIONS





# DCM-2 HART INTERFACE *Communication*

The DCM-2 board is the control center of the drive. Drive configuration and calibration are accessed and set through the DCM-2 board. Using the HART interface requires a HART® compatible communicator. Typically, a universal model 275/375 HART® communicator is used, but any device, computer or controller capable of communicating with HART® devices and supporting the Beck DCM-2 device description can be used. **This instruction supports drives built after 12/1/06 equipped with a DCM-2 (p/n 22-5012-59). The DCM-2 is designed to interface using a new universal device description (BECK-MK2) but the firmware can be set to closely emulate older revisions thus allowing a HART communicator to interface with the new DCM-2 using an earlier revision device description. This is an emergency feature for when HART communications are necessary, but the user does not have a new DD. To access all DCM-2 features and ensure that all engineering units are correctly displayed, the user must load the BECK-MK2 device description to the communicator. See page 69 for the serial command required to set the firmware “HART type”. Please contact the factory for instructions regarding setting the HART type using a handheld communicator.**

## HART® INTERFACE

Figure 1, page 34, displays the interface menu tree for communicating with a DCM-2 using the BECK-MK2 Device Description. This menu tree summarizes possible setup options, features and available information.

## HART® COMMUNICATORS FOR BECK-MK2

The BECK-MK2 Device Description requires a HART® Communicator that is fully HART 5 capable and has the ability to import Device Description Language Files (DDL) that are certified by the HART® Communications Foundation.

## USING THE HART® COMMUNICATOR

The HART® Communicator leads should be connected in parallel with the analog Demand signal wiring (see Figure on page 35). This allows the communicator to simultaneously communicate over the analog input wires. This does not disturb the analog command signal, or disrupt the DCM-2 functions. However, any program changes to the DCM-2 will momentarily suspend the operation of the board (maintains last state) while the change is implemented. Typically, this is only for a second or two.

With the communicator connected in parallel anywhere across the analog Demand wires, it is ready to communicate. Turn on the communicator and wait for communications to be established. Once communicating, the “Online” display (Figure 1, menu block #1) will appear in the communicator window. If the drive is multidropped with other devices on a single HART® network, the first display screen will list all devices and require a selection before the “Online” display is shown. The “Online” display provides online information about the present drive operating conditions. Entering any of the menus shown in Figure 1 is accomplished by following the display and using the communicator’s arrow keys. **If the communicator is unable to communicate with the DCM-2, it will display the message, “No Device Found”. If this occurs, check to make sure the leads are securely connected to the Demand wiring and retry. If communications still do not occur, the communicator polling setup may be improperly set. Check the “utility” menu and make sure communications polling is set to “always poll”.**

A communicator keypad and display is shown on page 35. There are four sections: 1) the liquid crystal message display, 2) four function keys beneath the LCD display, 3) six navigational keys in the center section, 4) alphanumeric entry keys at the bottom. For a complete description of the communicator, please see the HART® Communicator manual that is shipped with the communicator.

The alphanumeric keys are used to type in entries. Whenever a selected menu or method requires a value or description to be entered, this key pad is used. Since each key represents four different characters, three shift keys are provided at the bottom of the pad. A particular alphanumeric character is selected by pushing the shift key then pushing the alphanumeric key.

## MENU DESCRIPTIONS

(See Figure 1, Page 34)

### Online Menu

#### (Block 1)

When communications are established with the communicator, the Online menu is displayed. This is the gateway to all the other menus and it also provides current information about the drive. Numbered items 2 through 7 provide live, dynamic values of the drive's output position in percent, the Demand signal to the drive in percent, the Demand signal in milliamps, the torque output of the drive in percent, the drive temperature, and the external position feedback signal in milliamps. Select the first menu item, "Functions", to gain access to the Functions menu. Backing out of the Online menu (using the left arrow key) results in selection of the Offline menu.

### Functions Menu

#### (Block 2)

From the Functions menu, any of the DCM-2 functional menus can be selected and accessed. There are seven functional areas: Setup Checklist, Device Information, Configuration, Statistics, Manual Operation, Diagnostics, and Calibration Trim.

The Setup Checklist (Block 3A) is a menu that allows the user to setup the most important items necessary for basic drive operation. After completing the setup checklist, further setup can be accomplished using the configuration menu.

The other six functional areas and menus are described in more detail as follows.

### Device Information Menu

#### (Block 3B)

The Device Information menu is strictly an informational page. By entering this menu, a selection of useful information can be viewed and/or edited. There are a total of ten information entries:

1. **Tag** - This 8 character entry can be used as a unique label that correlates to a field device label.
2. **Descriptor** - This entry is a 16 digit field that can be used to provide any description desired.
3. **Message** - This entry is a 32 digit field that can be used to provide any message desired.
4. **Model** - This entry displays the model number of the drive in which the DCM-2 board is installed. It normally is set at the factory if the board is installed in a drive. The user can edit the field if desired.
5. **Drive S/N** - This entry displays the serial number of the drive in which the DCM-2 board is installed. It normally is set at the factory if the board is shipped in a drive. If the DCM-2 is shipped as a spare or replacement part, the "Drive S/N" field will be blank. The user can edit the field if desired.
6. **Installed** - This is a date entry that is normally used to indicate the date that the drive or DCM-2 board was installed. The date format is mm/dd/yyyy and it can be edited.
7. **Setup** - This is a date entry that is normally used to indicate the date that the DCM-2/drive setup was performed. Although this entry is viewed and can be edited in the "Device Information" menu, the user is prompted at the end of performing a "Setup" to enter a date. Entering the date at the prompt automatically updates the date displayed. The date format is mm/dd/yyyy, and it can be edited.
8. **Calibrated** - This is a date entry that is normally used to indicate the date that the DCM-2/drive was last calibrated. Although this entry is viewed and can be edited in the "Device Information" menu, the user is prompted at the end of performing any "Calibration" method to enter a date. Entering the date at the prompt, automatically updates the date displayed here. The date format is mm/dd/yyyy, and it can be fully edited.
9. **Review** - Scrolls through all device information items, as well as all the other DCM-2 settings, without accessing each item individually. This is an excellent tool for quickly determining how a particular drive is setup. To edit individual entries, the user must exit "Review" and proceed to the appropriate menu and item.
10. **Poll Address** - This entry can be edited; however, it is normally set to 0. A polling address from 1 to 15 can be entered if the drive resides on a common HART® network with other HART® devices.

# DCM-2 HART INTERFACE *Communication*

## Configuration Menu (Block 3C)

The Configuration menu serves as the gateway to all of the drive operating setup parameters. The user can select any of five different setup submenus that can be used to configure the drive based on the physical layout and the desired operation. The five setup submenus are described below. In addition to these five setup menus, there is a "Restore to Factory" selection which resets the drive configuration to its as-shipped settings. There is also a "User Default Setup" setting which resets the drive configuration to the settings typical of the applicable drive model type.

## General Setup Submenu (Block 4B)

This menu sets drive operating parameters. The nine parameter entries are as follows:

1. **Drive dir** - Defines the rotation of the drive output shaft, given an increasing Demand signal, looking into the output shaft. Options available are clockwise (CW) or counterclockwise (CCW).  
When the drive direction parameter is changed, the DCM-2 automatically reverses the analog position feedback signal such that it is 4 mA at the 0% input signal position and 20 mA at the 100% position. No recalibration of the CPS is required. This parameter is normally set to CW on an increasing Demand signal unless the user specified CCW prior to shipment of the drive.
2. **MaxTravel** - The maximum available travel distance of the output shaft in degrees. This value is entered manually, and must correspond to the actuator design.
3. **Travel** - The number of degrees of output shaft travel for 100% span. Edit this value to use a span shorter than the allowable "MaxTravel".
4. **StepSize** - The typical change in Demand signal that can occur before the output shaft will reposition (expressed in percent of span).
5. **Stall time** - The DCM-2 provides stall protection to the entire drive by shutting off power to the motor and providing a HART® alarm. This entry configures the stall time required to trigger the stall protection. At the factory, stall time is normally set to 300 seconds, but can be edited and set for any value between 30 and 300 seconds. This value should be longer than the timing for full drive travel.

6. **StallProt** - This entry is set as either "Enabled" or "Disabled". It is used to remove motor power if "Stall time" is reached.
7. **LimitSwitch** - This entry is set as either "Accept" or "Alert" and is used to define whether contacting a limit switch outside of the normal travel range (0% to 100%) will cause an error condition.
8. **PositionUnit** - Sets the numeric unit of measure for the output shaft position in degrees ("deg").
9. **Temperature Unit** - The unit of measure for temperature. May be set for Fahrenheit ("degF") or Celsius ("degC").

## PositionSnsrSetup Submenu (Block 4C)

This menu is where all position sensor and external position feedback signal setup is performed. The eight parameter entries are as follows:

1. **Set Pos 0%** - Selecting this parameter sets the present position of the drive to the minimum travel position. Equivalent to pushing the SET POS 100% pushbutton.
2. **Set Pos 100%** - Selecting this item sets the present position of the drive to the maximum travel position. Equivalent to pushing the SET POS 100% pushbutton.
3. **PresCPS V** - Displays the present value of the internal Position Sensor voltage, which may also be measured at TP4(+) and TP1(-) on the DCM-2 board. May be edited in the Calibration Trim menu for trimming the Position Sensor A/D converter.
4. **CPS Zero%** - Displays the CPS voltage at the zero percent output shaft position. May be edited to define the CPS voltage at the lowest operating point of travel.
5. **CPS Span** - Displays the CPS voltage span for the maximum allowable output shaft travel.
6. **CPS RngLwr** - Displays the CPS voltage at the lowest available point of travel. Normally set by the factory.
7. **CPS RngUpr** - Displays the CPS voltage at the highest available point of travel. Normally set by the factory.
8. **Pos S/N** - A number which uniquely identifies the position sensor. May be edited.
9. **Snsr Dir** - Displays which direction of output shaft movement will yield an increasing internal Position Sensor signal. Normally set at factory to "CW Incr" (signal increases as the output shaft rotates CW).

## Demand Setup Submenu (Block 4D)

This menu is where all the Demand input signal related drive parameters are set. The eight parameter entries are as follows:

1. **DemRngLwr** - The value of the Demand signal (in mA) that corresponds to 0%. Normally set to "4.00 mA", this value should be set above the "DemLimLwr" value.
2. **DemRngUpr** - The value of the Demand signal (in mA) that corresponds to 100%. Normally set to "20.00 mA", this value should be set below the "DemLimUpr" value.
3. **Dem Curve** - Allows a choice in the relationship between the applied Demand signal and the desired position of the output shaft. Choices are: Linear, Square Root, Dem Curve Special, & Square.
4. **Dem Curve Spcl** - When "Dem Curve" above is set to "Special", this command allows access to a submenu to setup the preferred Demand curve.
5. **Los Mode** - Sets the output shaft response to a loss of Demand signal condition. Can be set to "Stay" or "Go-to-Pos".
6. **Los Pos** - If "Los Mode" has been set to "Go-to-Pos", this parameter allows the user to define the position (in percentage of travel) to where the output shaft will move during Loss of Signal conditions. May be set between -5.00% and 105.00%.
7. **DemLimLwr** - Sets the minimum usable value of Demand. Below this value, the Loss of Signal condition will be set. Values between 0 mA and 12 mA may be selected. This value should be set lower than the low Demand Range ("DemRngLwr").
8. **DemLimUpr** - Sets the maximum usable value of Demand. This value should be set higher than the upper Demand Range ("DemRngUpr").

## Feedback Setup Submenu (Block 4E)

This menu is where all the Feedback signal related drive parameters are set. The four parameter entries are as follows:

1. **FBRngLwr** - The value of the Feedback signal (in mA) that corresponds to a 0% output shaft position. This value can range between 3.0 mA and 16.0 mA.
2. **FBRngUpr** - The value of the Feedback signal (in mA) that corresponds to a 100% output shaft position. This value can range between 7.0 mA and 21.0 mA.

3. **Feedback** - Enables or Disables the Feedback signal.
4. **FB Curve** - Allows a choice in the relationship between the applied Feedback signal and the actual position of the drive. Choices are: Linear & Inverted Demand ("InvDem").

## Torque Setup Submenu (Block 4F)

This menu is where all the Torque related drive parameters are set. The five parameter entries are as follows:

1. **Trq/Thrust** - Enables or Disables torque related functions.
2. **Ovt Prot** - Enables or Disables over-torque protection, which will remove power from the motor if excessive torque is detected.
3. **AlarmLevel** - Sets the value that, if exceeded, will cause the Torque Alarm to activate.
4. **ShutDwnTrq** - Sets the value that, if exceeded, will cause the power to be removed from the motor (if "Ovt Prot" is enabled; see above). This will cause a shutdown alarm.
5. **Trq Null** - Sets the torque value that corresponds to 0% torque applied. This number is represented in "TK" units, and is noted on the label inside the DCM-2 cover (also referred to as "Torque Zero").
6. **Trq Const** - Sets the torque value that corresponds to 100% torque applied. This number is represented in "TK" units, and is noted on the label inside the DCM-2 cover.

## Statistics Menu (Block 3D)

This menu is where all the drive's stored operating statistics are available. There are eight different statistics available:

1. **Starts** - Logs and displays the total number of starts the drive motor has made.
2. **Reversals** - Logs and displays the total number of times the motor started in a direction opposite to the previous start.
3. **Stalls** - Logs and displays the total number of stalled conditions the drive has experienced. For the drive to register a stall, the DCM-2 board must be unable to balance the drive position against the Demand input signal for a period exceeding the **Stall Time** set in the General Setup menu.
4. **OverTorques** - Logs and displays the total number of times that excessive torque was detected at the output shaft.
5. **Pk Torque** - Logs and displays the maximum torque sensed at the output shaft.
6. **TotRunTm** - Logs and displays the total run time of the drive motor in seconds.
7. **High temp** - Logs and displays the highest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM-2 board.
8. **Low temp** - Logs and displays the lowest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM-2 board.

## Manual Operation Menu (Block 3E)

This menu is used to allow manual drive operation with the HART® communicator. There are three manual operation procedures available:

1. **Op mode** (Block 4G) - This procedure allows the user to select the operating mode of the DCM-2. There are four possible choices: "Follow", "Hold", "Stay" and "Stop". The "Follow" mode is the normal state of operation and allows the DCM-2 to control the drive operation by responding to the analog input Demand signal when the drive Handswitch is in the automatic position. The "Hold" mode causes positioning according to the HART Interface Demand Value. The "Stay" mode causes the output shaft to remain stationary and maintain its present position. Note that in "Stay" mode, the Handwheel cannot be freely turned. The "Stop" mode removes power from the motor. Note that in "Stop" mode the Handwheel can be freely turned. All operating modes can be overridden by the drive Handswitch.
2. **Demand** - This procedure sets the effective Demand signal. If **Op mode** is set to "Hold", entering a valid value (-5% to 105%) will control the motor. If **Op mode** is set to "Follow", the value will follow the Demand analog signal (unless an alarm condition exists).
3. **Reset Stall** - This procedure resets normal drive operation after a stall condition has caused the drive to shut down. Selecting this option and following the prompts will restore operation. Note that stall conditions can also be reset by simply reversing the input Demand signal or cycling the drive ac power.



## Diagnostics Menu (Block 3F)

This menu provides access to all the DCM-2 stored online diagnostic information about drive operation. The menu provides six submenus accessing drive statistics and online drive status.

## Status Submenu (Block 4H)

This menu provides access to six submenus displaying various drive status settings: LED Status, Operating Status, Switch Status, Local Cntrl Status, CW Inhibitors, and CCW Inhibitors.

## LED Status Submenu (Block 5B)

This menu displays the ON or OFF status of each of the LEDs on the DCM-2. See below.

LED NAME	HART NAME	DESCRIPTION
STAT	"Status"	"ON indicates that an operating condition is inappropriate see Operating Status menu"
REV	"Reverse"	"ON indicates that the Demand signal is less than the Position signal"
FWD	"Forward"	"ON indicates that the Demand signal is greater than the Position signal"
DEM_ERR	"Demand"	"ON indicates that a Demand error condition exists check the operating mode settings"
POS_ERR	"Position"	"ON indicates that the Position signal may be out of range or saturated"
TORQ_ERR	"Trq/Thrust"	"ON indicates that the Torque or Thrust sensor signal may be out of range or saturated"
STALL_ERR	"Stall"	"ON indicates that the motor may be stalled"
TEMP_ERR	"Temperature"	"ON indicates that a temperature fault exists"
FB_ERR	"FB Open"	"ON indicates that the feedback loop is open or out of range"
STOP_ERR	"Limit"	"ON indicates that a limit switch has been triggered"
ACKN_ERR	"Acknowledge"	"Acknowledge indicator is active"

## Operating Status Submenu (Block 5C)

This menu displays the ON or OFF status of eight drive parameters: Dem Limits, Pos Limits, Temp Limits, Torq Limits, Over-Torq Stop, Stalled, Feedback Open, and Switch Block. See below.

CONDITION	DESCRIPTION
DEMAND_LOS	"The Demand Signal is outside of the intended limits (see Demand Setup menu)"
TRQ_THRUST_OVERRANGE	"The Torque/Thrust is greater than the output rating"
STALL	"Stall condition has been detected (see General Setup menu)"
OVERTRQ_THRUST_PROTECTION	"Motor power has been removed due to excessive output thrust"
STOP_OR_LIMIT	"Motor power is blocked check switches"
FEEDBACK_DISCONNECTED	"The Feedback signal is enabled but the loop is open"
TEMPERATURE_OVERRANGE	"The temperature is outside of -40F to 185F"
POSITION_OVERRANGE	"The Position signal is less than -5% or greater than 105%"

## Switch Status Submenu (Block 5D)

This menu displays the ON or OFF status of the eight switch parameters: LV Lim CCW, LV Lim CW, OvrRd CCW, OvrRd CW, OvrRd Stop, HndSw CCW, HndSw CW, and HndSw AUTO. The Switch Status menu displays the status of the CW/CCW control override input, the STOP control override or if the Handswitch is in the CW/CCW or AUTO position.

## Local Control Status Submenu (Block 5E)

This menu displays the ON or OFF status of five local interface drive parameters: Calibrate, Set Pos 100%, Set Pos 0%, Set Dem 100%, and Set Dem 0%. The Local Control Status submenu indicates which buttons on the Local Control board are pressed.



# DCM-2 HART INTERFACE *Communication*

## CW Inhibitors Submenu (Block 5F)

This menu displays the ON or OFF status of the contributing sources of retract movement inhibitors of motor operation: Balance, Supervisory, Stall, OverTrq/Thr, Switch Block, Bad Pos Sig, Bad Dem Sig, Local Cal. See below.

CONDITION	DESCRIPTION
Balance	"ON indicates that the Demand and Position are at balance"
Supervisory	"ON indicates that the DCM is initializing"
Stall	"ON indicates a Stall condition"
OverTrq/Thr	"ON indicates that the motor is stopped due to excessive torque or thrust"
Switch Block	"ON indicates that the Handswitch, Override, or Limit Switch is inhibiting movement"
Bad Pos Sig	"ON indicates that the Position signal is out of range"
Bad Dem Sig	"ON indicates that the Demand signal is out of range"
Local Cal	"ON indicates that a Local Calibration button is pressed"

## CCW Inhibitors Submenu (Block 5G)

This menu displays the ON or OFF status of the contributing sources of extend movement inhibitors of motor operation: Balance, Supervisory, Stall, OverTrq/Thr, Switch Block, Bad Pos Sig, Bad Dem Sig, Local Cal. See table above.

## Tests Submenu (Block 4I)

This menu provides procedures that allow the user to test, identify and reset the DCM-2 board. They are as follows:

1. **FB out test** - This procedure allows the user to test the 4–20 mA position feedback output signal. Following the prompts through this procedure allows the user to physically verify the output signal value at 4 mA, 20 mA, and anywhere in between.
2. **Board self-test** - This procedure runs an automatic board test that verifies the health of the DCM-2 control board. It runs a checksum memory test and checks for the proper installation of the position sensor (CPS rotor). Running the test causes the drive to reposition temporarily, so it should only be run offline. The CPS test runs automatically as part of some calibration and setup procedures. This test should be implemented only if a DCM-2 problem is suspected.

3. **Identify Device** - This command will cause the Acknowledge LED to blink for two seconds. Used to verify proper HART communications as well as an aid in identifying which drive is being addressed when configuring multiple drives for split range operation.
4. **Board reset** - This procedure resets the board without powering down the drive. There are many communicator procedures that implement the reset procedure automatically to ensure the proper initialization of the DCM-2 board; however, manually implementing the reset procedure is not typically necessary.

## CW Torque Submenu (Block 4J)

This menu displays the torque applied over ten segments of travel of the drive shaft.

## CCW Torque Submenu (Block 4K)

This menu displays the torque applied over ten segments of travel of the drive shaft.

## Alarm Setup Submenu (Block 4L)

This menu allows customization of alarm indication:

1. **AlarmPol** - This determines whether the alarm relay "Drops Out" or "Pulls In" to indicate an alarm.
2. **Alarm Mask** - This leads to a submenu where alarm conditions may be set.

## Alarm Mask Submenu (Block 5H)

This menu allows alarm conditions to be ignored; such as DemandLOS, Stall FeedbackLOS, or other conditions which may occur under normal operation and that may prove a nuisance during normal HART operation.

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## RealTimeClock Submenu (Block 4M)

This menu allows the date and time to be set. The settings are as follows:

1. **RTC Day** - Numerical entry sets the day of the month.
2. **RTC Month** - Numerical entry sets the month.
3. **RTC Year** - Numerical (4 digit) entry sets the year.
4. **Hour (24)** - Numerical entry sets the hour of the day (1–24).
5. **Minute** - Numerical entry sets the minute of the hour.

## Calibration Trim Menu (Block 3G)

This menu displays/sets drive calibration values:

1. **PresCPS V** - Displays the present value of the internal Position Sensor voltage. This value can also be measured at TP4(+) and TP1(–) on the DCM-2 board. This value can be edited to trim the Position Sensor.
2. **Loop(Dem)** - Displays the Demand signal as measured at the field wiring terminals. When the Demand control loop signal is being overridden by a special mode of operation, the effective Demand will not correspond to the mA value. This value can be edited to trim the Demand to ensure accurate measurement of the analog signal. Demand can only be trimmed at 4.0 mA and 20.0 mA.
3. **Feedback** - Displays the mA signal representing the output shaft position as measured at the field wiring terminals. This value can be edited.
4. **Trq/Thrust** - Displays the load measured at the output shaft as a percentage. This value can be edited.

# DCM-2 HART INTERFACE *Configuration and Setup*

All drives are shipped completely configured to the customer's specifications and are ready to be installed. If the need arises to change the configuration of the drive (i.e., change one or more of the setup parameters that define how the drive operates), this may be accomplished utilizing the HART® interface and a communications tool (model 275 or 375 HART® Communicator) as described in the Communications section of this manual. This section of the manual covers how the drive is configured and gives instructions for changing each particular setup parameter available. It is intended to build upon the Communications Section, which provides a detailed description of the HART® Menu Tree and defines all the parameters and commands. **If unfamiliar with the HART® communicator and Beck drives, please review the Communications section before proceeding.**

There are a number of configuration setup parameters that can be changed to custom tailor the drive's operation to the application needs. The remainder of this section provides instructions for changing each of these parameters. The instructions below assume that the user has a model 275 HART® Communicator attached to the Demand wiring (at drive terminals AA and BB or anywhere across the wires all the way back to the source of the Demand signal), has established communications with a particular drive, and has a copy of the HART® Menu Tree (Figure 1, page 34) available.

## DRIVE SHAFT TRAVEL

Drive shaft travel refers to the direction the output shaft of the drive moves in response to an increasing Demand input signal. The travel is either clockwise (CW) or counterclockwise (CCW). The control loop operation and physical design of the final control element determine the drive travel suitable for an application. If the drive travel needs to be changed, this is easily accomplished by changing the DCM-2 configuration.

### Changing Drive Shaft Travel

**STEP 1** - From the HART® communicator "Online" menu, move to the "General Setup" menu and select the "Drive Dir" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the "Drive Dir" parameter selected, press the right arrow key to display the two entry choices: "CW incr" and "CCW incr". Use the up and down arrow keys to select the desired parameter.

**STEP 3** - With desired parameter selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the "General Setup" main menu.

**STEP 4** - At the bottom of the "General Setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

### WARNING

**Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter will cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.**

## STEP SIZE

The step size is the incremental movement of the drive shaft in response to signal changes. The step size is factory set at 0.15% unless otherwise specified at the time of order. The step size is adjustable from 0.1% to 2.5%. To adjust the step size, please follow the steps below.

### Changing the Step Size

**STEP 1** - From the HART® communicator "Online" menu, move to the "General Setup" menu and select the "StepSize" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the "StepSize" parameter selected, press the right arrow key to display the modifiable entry box, and using the alphanumeric keypad, type in the desired dead band value. Values between 0.1% and 2.5% are valid.

**STEP 3** - With the desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the "General Setup" main menu.

**STEP 4** - At the bottom of the "General Setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

### WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing drive setup parameters can cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

## STALL PROTECTION

The DCM-2 board provides protection of the drive motor and gearing in the event of a stalled condition. The board accomplishes this by sensing that the drive is unable to balance for a set period of time known as the “stall time”. If the DCM-2 is unable to balance the drive for a period greater than the stall time, it shuts off power to the motor and prevents the drive from continuing to operate against the stall. Resetting the drive and restoring normal operation is achieved in several ways: Reversing the Demand signal to the drive, performing a stall reset procedure (see Manual Operation Menu, Figure 1, page 34), performing a board reset procedure (see Diagnostics Menu, Figure 1, page 34), or cycling the drive ac power.

## Changing Stall Time

**STEP 1** - From the HART® communicator “Online” menu, move to the “General Setup” menu and select the “Stall Time” parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the “Stall Time” parameter selected, again press the right arrow key to display the modifiable entry box, and using the alphanumeric keypad, type in the desired stall trigger time value. It is normally set to a maximum of 300 seconds, but can be changed to a minimum of 30 seconds.

### WARNING

It is possible that the stall time can be set to a value less than the full travel time of some drives. This could lead to false stall conditions when making very large changes. Typically, this would only occur during start-up, shut down or some other condition that might require a large change in Demand from the controller.

**STEP 3** - With the desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the “General Setup” main menu.

**STEP 4** - At the bottom of the “General Setup” menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

### WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing drive setup parameters can cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

## OVERTRAVEL ANNUNCIATION

When communicating with the DCM-2 via the 275 HART® Communicator, a number of different informational messages may be displayed for certain conditions that may exist. One such message is “H/S in STOP or drive at limit sw”. This is displayed anytime the DCM-2 is attempting to reposition the output shaft, but is unable to due to a break in the electrical power to the motor. This can happen if the Handswitch is put in STOP or if an over-travel limit switch is open. Normally, this is a useful message that should be displayed; however, in certain situations like split range operation (see split ranging, page 57), it can become a nuisance. For example, in a split range operation one or more of the drives will be interpreting the Demand input signal as out of range (i.e., either above 100% Demand or below 0% Demand) and will be against an over-travel limit switch at any given time. Since this is normal for split range operation, the message will be a nuisance rather than informational.

Setting the “Overtravel Annunciate” feature to “Ignore” will eliminate the message, but only when the Demand signal is above 100% or below

## OVERTRAVEL ANNUNCIATION, CONT'D.

0% and an over-travel limit switch is open. This eliminates the nuisance message, but does not eliminate the message for other scenarios like the Handswitch being in the STOP position.

## Changing Overtravel Annunciation

**STEP 1** - From the HART® communicator "Online" menu, move to the "General Setup" menu and select the "LimitSwitch" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the "LimitSwitch" parameter selected, again press the right arrow key to display the modifiable entry box, select either "Accept" to turn off the HART warning or "Alert" to ensure the HART warning is transmitted.

**STEP 3** - With the desired selection highlighted, push the F4 function key (which is defined as the ENTER key at the bottom of the display). Pushing this key enters the value and reverts the display back to the "General Setup" main menu.

**STEP 4** - At the bottom of the "General Setup" menu, the F2 function key should now be defined as the SEND key. Push this key to execute the change.

## POSITION FEEDBACK SIGNAL

DCM-2 boards are equipped with a Feedback Sourcing module that provides a 4–20 mA analog output signal that represents the drive output shaft position in terms of 0–100% of full directional travel. This signal can be remotely monitored or used by a controller or indicator. The user has the option of enabling or disabling the signal. Normally, the signal should be enabled, but in a situation where the feedback is present, but unused (i.e., not wired to a load) a HART® alarm message will be present while communicating using the 275/375 Communicator. This message is helpful in alerting the user to open feedback wiring, but it is a nuisance when the feedback is purposely disconnected or unused. Disabling the feedback signal turns off the output and eliminates the message.

## Enabling / Disabling Position Feedback Signal

**STEP 1** - From the HART® communicator "Online" menu, move to the "Setup Checklist" menu and select the "Feedback" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the "Feedback" parameter selected, press the right arrow key to display the two entry choices: "Enabled" or "Disabled". Use the up and down arrow keys to select the desired parameter. "Enabled" enables the output signal, while "Disabled" disables the output.

**STEP 3** - With desired choice selected, push the F4 function key which is defined as the ENTER key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the "Setup Checklist" main menu.

**STEP 4** - At the bottom of the "Setup Checklist" menu, the F2 function key should now be defined as the SEND key. Push this key to execute the change. This change should not effect drive positioning but, as with all configuration changes, **carefully follow the on-screen warnings and messages when proceeding.**

## DEMAND SIGNAL CHARACTERIZATION

The Beck DCM-2 is designed to receive a 4–20 mA (1–5 V dc) input Demand signal and respond by repositioning the drive output shaft in proportion to the signal. There are four ways in which the DCM-2 can interpret the Demand signal: Linear, Square Root, Dem Curve Special and Square. The Linear interpretation, which is most commonly employed, simply causes the drive to position the output shaft in a one-to-one relationship with the Demand. For example, a 1% change in Demand always causes a 1% position response. The Square Root relationship produces a response proportional to the square root of the Demand Signal. The Dem Curve Special relationship allows a customized Demand curve to be setup through a special submenu. The Square relationship produces a non-linear drive response proportional to the square of the Demand signal. For example, a 25% input Demand is interpreted as  $0.25^2$  or 0.0625 (6.25%). The square relationship helps to linearize flow response of final control elements that have quick opening characteristics.



## Changing Characterization

**STEP 1** - From the HART® communicator “Online” menu, move to the “Demand Setup” menu and select the “Dem Curve” parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the “Dem Curve” parameter selected, press the right arrow key to display the four entry choices: “Linear”, “Square Root”, “Dem Curve Special” or “Square”. Use the up and down arrow keys to select the desired parameter.

**STEP 3** - With desired choice selected, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the “Demand Setup” main menu. If “Dem Curve Special” is selected, proceed to the “Dem Curve Special” sub-menu to setup the desired curve.

**STEP 4** - At the bottom of the “Demand Setup” menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

### WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter online will cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

## LOSS OF DEMAND INPUT SIGNAL

The DCM-2 board has the capability of determining when the Demand input signal to the drive is lost, and then responding in the method most appropriate for the application. There are three setup parameters that must be configured in order to define this capability: “LOS Mode”, “LOS Pos” and “DemLimLwr”. The “LOS Mode” parameter determines how the drive should respond to the loss of the Demand input signal. It can be configured as “STAY” (which means the drive holds its current position when the signal is lost) or “GO-TO-POSITION” (which means the drive moves to a predetermined position). If the “Go-to-Pos” option is selected, the “LOS Pos” parameter is used to determine what output shaft position the drive must achieve when the input

is lost. Finally, a loss of signal is sensed by the DCM-2 when the signal drops below the value set by the “DemLimLwr” parameter. This value is represented in mA of the Demand input signal range. Therefore, the standard 3.2 mA value normally used for this parameter suggests that when the Demand input signal drops 5% below the calibrated 0% value, the DCM-2 senses a lost Demand input and executes the configured loss-of-signal action.

## Changing Loss (LOS) of Signal Action

**STEP 1** - From the HART® communicator “Online” menu, move to the “Demand Setup” menu and select the “LOS Mode” parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the “LOS Mode” parameter selected, press the right arrow key to display the two entry choices: “Stay” or “Go-to-Pos”. Use the up and down arrow keys to select the desired parameter.

**STEP 3** - With desired choice selected, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the “Demand setup” main menu. If the “Go-to-Pos” choice was selected, go to **STEP 4**, if “Stay” was selected, go to **STEP 6**.

**STEP 4** - After entering “Go-to-Pos”, select the “LOS Pos” parameter and use the right arrow key to display the modifiable entry block. Unless otherwise specified, this value is set to 50% at the factory. Using the alphanumeric keypad, enter the desired loss of signal position as a percentage of full output shaft travel. Values from -5% to 105% are valid.

**STEP 5** - With desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the “Demand Setup” main menu.

**STEP 6** - At the bottom of the “Demand Setup” menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.



## WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter online could cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

## Changing LOS Trip Point

**STEP 1** - From the HART® communicator “Online” menu, move to the “Demand Setup” menu and select the “DemLimLwr” parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the “DemLimLwr” parameter selected, press the right arrow key to display the modifiable entry block. Using the alphanumeric keypad, enter the desired Demand signal lower limit value in mA outside of the Demand signal range.

**STEP 3** - With desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the “Demand Setup” main menu.

**STEP 4** - At the bottom of the “Demand Setup” menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

## WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter online could cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

## TORQUE OPTIONS

DCM-2 boards have the capability to measure the drive’s torque output. This, in turn, makes it possible to provide several torque-related features. The features include a live display of the torque output on the 275/375 HART® Communicator display or any other device capable of communicating and displaying HART® transmitted variables. Included is the ability to store peak torque values within the DCM-2 and view them by accessing the device information menu. To protect the drive gearing and related equipment, the drive can be configured to shut off if the torque exceeds 150% of the drive torque rating. And finally, the DCM-2 will provide a high torque alarm, via HART® communications, that alerts the user to a high torque condition when the torque output exceeds a set value (normally set at 105% of the drive rating).

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## Enabling Torque Functions

**STEP 1** - From the HART® communicator “Online” menu, move to the “Torque Setup” menu and select the “Trq/Thrust” parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the “Trq/Thrust” parameter selected, press the right arrow key to display the two entry choices: “Enabled” or “Disabled”. Use the up and down arrow keys to select the desired parameter. Enabling this parameter will activate the torque measurement features and displays, while disabling the parameter will turn them off.

**STEP 3** - With the desired choice selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the “Torque setup” main menu. **Carefully follow the on-screen warnings and messages to return to normal operation.**

## Enabling Over-torque Protection

**STEP 1** - From the HART® communicator “Online” menu, move to the “Torque Setup” menu, make sure that the “Trq/Thrust” parameter is enabled (if not, enable it using the prior procedure) and select the “Ovt Prot” parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

**STEP 2** - With the “Ovt Prot” parameter selected, press the right arrow key to display the two entry choices: “Enabled” or “Disabled”. Use the up and down arrow keys to select the desired parameter. Enabling this parameter will activate the over-torque protection, while disabling the parameter will turn it off.

**STEP 3** - With the desired choice selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the “Torque Setup” main menu.

**STEP 4** - At the bottom of the “Torque Setup” menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change. This change should not effect drive positioning but as with all configuration changes, **carefully follow the on-screen warnings and messages when proceeding.**

## DCM-2 HART INTERFACE *Calibration*

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All Beck drives are shipped completely calibrated to the customer specifications, and are ready to be installed. If the need arises to change the drive calibration, confirm that the drive is installed as specified and operating properly before proceeding with the change. It is also helpful to verify the drive configuration. This can be done by reviewing the settings in the Configuration menu.

With the exception of the settings for the over-travel limit switches, auxiliary limit switches and CPS, all calibration is performed using the HART interface and a communications tool (model 275/375 HART Communicator), as described in the Communications section of this manual. If unfamiliar with the HART communicator and Beck drives, please review the Communications section of this manual before continuing.

The DCM-2 can be calibrated by using the "Position Setup" and "Demand Setup" menus.

Normally, calibration should not require adjustment; however, if the Position or Demand requires minor adjustment, the "Calibration Trim" menu may be used.

Any calibration changes that are made using any of the above described methods, can be reversed by using the "Restore to Factory" feature in the "Configuration" menu. Note that implementing the "Restore to Factory" feature returns all settings to the as-shipped factory settings.

## DIRECTION OF SHAFT ROTATION (CW VERSUS CCW)

Direction of shaft rotation is determined when looking at the end of the output shaft (see figures below). Direction of rotation is defined as the direction of output shaft rotation produced by an increasing demand signal. Unless otherwise specified at the time of order, the output shaft is factory-set to rotate clockwise in response to an increasing signal.

## CALIBRATION PRIORITY

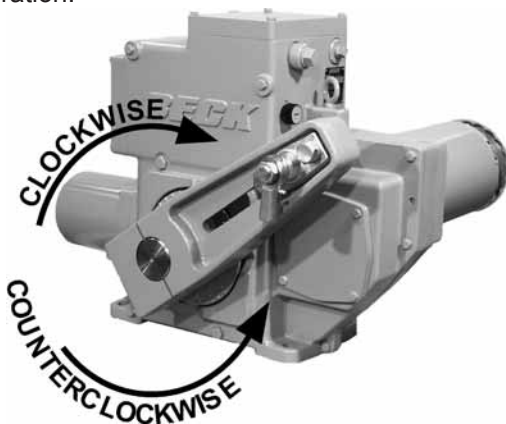
### Models 11-159, -209, -309 & -409

Standard Group 11 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft rotation must occur within these stops, which are approximately 108° apart.

The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart than the drive's intended full range of electronic operation (typically 100°). The limit switches are positioned to provide an electrical overtravel protection (typically 101°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 100° rotation (see page 55)—it may be desirable to reset the over-travel limit switches (see page 52). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. It is best to calibrate the drive and then set the limit switches when short-stroking the drive. The switches should be set just outside the calibrated range to avoid tripping the switch at the 0% and 100% positions.

The auxiliary switches are also cam operated, but have no affect on drive and DCM-2 operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.



### Models 11-169, -269, -369 & -469

Standard Group 11 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft rotation must occur within these stops, which are approximately 108° apart; except for the 11-169 stops, which are 98° apart.

The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart than the drive's intended full range of electronic operation (typically 90°). The limit switches are positioned to provide an electrical overtravel protection (typically 91°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 90° rotation (see page 55)—it may be desirable to reset the over-travel limit switches (see page 52). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. Because the over-travel limit switches define the maximum electrical drive range, if they are to be reset, they should be adjusted before performing DCM-2 (demand and position) calibration procedures.

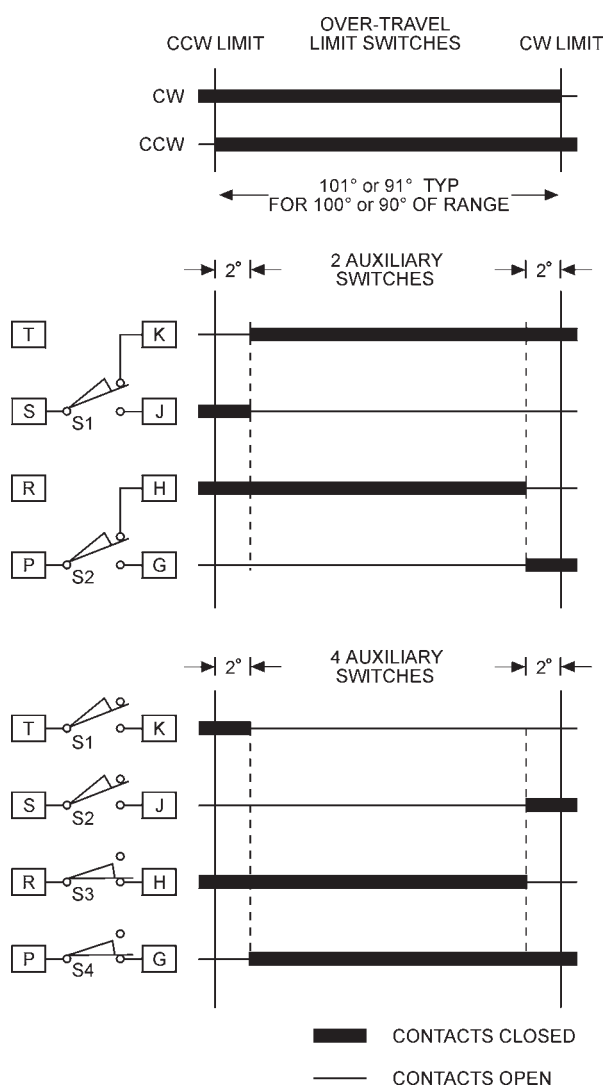
The auxiliary switches are also cam operated, but have no affect on drive and DCM-2 operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.



# DCM-2 HART INTERFACE *Calibration - Switches*

**NOTE: Your Beck drive was shipped from the factory ready for installation; no electrical adjustments are required before placing it in operation. Each drive is set up and calibrated to the specifications that were written into the equipment order.**

Under normal operating conditions there is no need to recalibrate the control drive. However, if the application requirements change or are different than specified on the equipment order, the drive should be recalibrated according to the following procedures.



**Standard Over-travel Limit and Auxiliary Switch Settings**

## SWITCH ADJUSTMENTS

Control drives are shipped with over-travel limit switches factory-set for either 101° (11-159, -209, -309, -409) or 91° (11-169, -269, -369, -469) of travel unless otherwise specified at time of order. Limit switches must be set inside the range of the fixed, non-adjustable, built-in mechanical stops to prevent stalling of the motor. Limit switches can be reset to limit travel of the output shaft to any angle down to a minimum of 60°. Auxiliary switches are set as shown in the figure at left unless otherwise specified at time of order.

**NOTE: The over-travel limit switches are the switches located closest to the drive body. To adjust the over-travel limit switches, it is necessary to remove the control end cover.**

Switches are operated by cams which are clamped onto the control shaft. Setting a switch involves loosening the cam, moving the output shaft to the desired position, and positioning the cam so that it just operates the switch at that point. In the following procedure, the use of a continuity meter is recommended to determine when the switch opens or closes. If such a meter is not available, it is possible to hear the switch click as the contacts open and close.

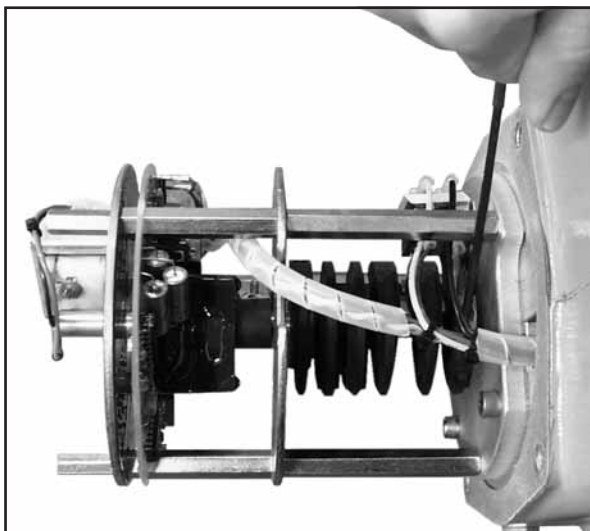
### CAUTION

**Do not attach the meter or attempt to move the switch cams until the drive is disconnected from the line voltage and auxiliary switches are disconnected from external power sources.**

## Setting Over-travel Limit Switches CW and CCW

This procedure should be used if the factory over-travel limit switch settings must be changed in the field. It is advisable to operate the drive fully in each direction, using the electric Handswitch to check switch settings before attempting to change them. Follow these instructions if they require adjustment:

1. Remove the control end cover and terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the control shaft so that the CW switch cam screw is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft (see illustration below).
3. Move the output shaft clockwise to the desired CW limit.
4. Turn the Handswitch to the "STOP" position.
5. **Disconnect power from the drive.**
6. Turn the Handswitch to the "AUTO" position.
7. Connect the continuity meter across terminals B and M. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
8. Tighten the cam locking screw to 5 lb-in (.56 N•m) torque.
9. Disconnect meter and turn the Handswitch to the "STOP" position.
10. Reconnect drive power.
11. Rotate the drive's output shaft in the CCW direction away from the CW travel limit. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever with the switch lever on the lower part of the cam. If not correct, return to step 2 and reset the cam to the proper orientation.
12. Rotate the output shaft again to the desired CW travel limit. If the stopping point is reached, the switch is properly set.



**Loosening Switch Cam**

13. Repeat instructions for setting CCW travel limit switch (noting that referenced directions of rotation should be opposite of those used for CW switch setting). Connect continuity meter across terminals B and N.
14. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.
15. Rotate index (or index pointer on models 11-159 or -169) to correspond with output shaft rotation.

## Setting Auxiliary Switches

Standard switch settings for drives with 2 or 4 auxiliary switches are shown on the diagram on page 54. The heavy line indicates a closed circuit. Follow these instructions to change the operating point of auxiliary switches:

**NOTE: In the following procedure, it is assumed that switch settings are to be adjusted so that contacts are open when the desired position is achieved. If they are to be adjusted to close, it may be necessary to reverse the operating mode of the switch by moving the wire lead to the other terminal on the switch itself. Be sure to disconnect power from the switch terminals first.**

1. Remove the control end cover and the terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the shaft so that the switch cam is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft.
3. Move the output shaft to the desired position.
4. Turn the Handswitch to the "STOP" position.
5. Disconnect power from the drive and switch terminals.
6. Connect the continuity meter across the appropriate terminals. See the diagram on page 17 or the drive wiring diagram. Rotate the cam to operate the switch.
7. Tighten the cam locking screw to 5 lb-in (.56 N•m) torque.
8. Disconnect the meter and reconnect power.
9. Move the drive's output shaft in the desired direction so that the cam lobe moves away from the switch lever. If not correct, return to step 2 and reset the cam to the proper orientation.
10. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.



## **POSITION SENSOR SETUP**

In order to correctly position the drive output shaft in response to the input Demand signal, the DCM-2 board receives a position signal from the drive's position sensor (CPS) and compares this actual position to the desired Demand input. This process requires that the DCM-2 interprets the CPS signal appropriately for the full range of desired travel. The "PositionSensrSetup" submenu is used to set the DCM-2 to accept the CPS position signal and interpret the appropriate 0–100% range.

All Beck drives are shipped completely set and calibrated to the customer specifications and are ready for installation. Normally, no adjustments are necessary.

If, however, the position calibration needs to be changed, the "PositionSensrSetup" submenu must be used. The "PositionSensrSetup" is accessible through the "Configuration" menu.

The "PositionSensrSetup" submenu will allow resetting of the minimum travel position of the drive (Set Pos 0%) and the CPS voltage at the minimum travel position (CPS Zero%). Online help is available through the communication device.

---

## Short-stroke Operation (Reducing Full Travel)

Typically, it is best to use the full 100% travel of the drive in response to the 0–100% Demand input signal.

In certain applications, as a last resort, it may become necessary to reduce the full travel of the drive. In these applications, the DCM-2 can be calibrated to accommodate reduced stroke. The recommended *minimum* full travel is 60%, although it is advisable to make the range as close to 100% as possible for the highest position resolution attainable with the CPS and to avoid possible reduction in torque.

Reducing the full travel is referred to as “short-stroking” the drive. This can be easily accomplished by using a HART communication device.

First, navigate to the Configuration menu. Select the General Setup submenu. Select the Travel parameter. Reduce the stroke by entering a percentage of full travel (not less than 60%) of the maximum travel of the drive.

## **FEEDBACK SIGNAL CALIBRATION**

DCM-2 boards have the capability of providing a 4–20 mA output signal so that the drive's true output shaft travel can be monitored remotely. The signal comes calibrated from the factory to provide a precise 4–20 mA signal corresponding to 0–100% drive travel. Normally, calibration is not required even if the position reference calibration or direction of travel are changed, because the DCM-2 automatically compensates for these changes and appropriately scales the position feedback signal.

If the Feedback must be changed, it is accomplished by using a Hart communication device. First, navigate to the Configuration menu. Next, select the Feedback Setup submenu. Through this submenu, the Feedback range may be changed, as well as the curve. Online help is available through the communication device.

# DCM-2 HART INTERFACE *Calibration - Demand*\_\_\_\_\_

## DEMAND SIGNAL CALIBRATION

DCM-2 boards are designed to accept a 4–20 mA (or 1–5 V dc) analog Demand signal. Narrower spans within this range can also be accommodated for split range operation (see explanation following). The input comes calibrated from the factory for the full range unless otherwise specified. It is not necessary to calibrate the Demand input when the drive is installed.

If the Demand must be changed, it is accomplished using a HART communication device.

First, navigate to the Configuration menu. Select the Demand Setup submenu. Through this submenu, the Demand range limits and curve specifications may be changed. Online help is available through the communication device.

## Split Range Operation

It is sometimes desirable or necessary to have more than one final control element controlling a single process. Often, this type of control strategy requires that two to four Beck drives each respond to different portions of one 4–20 mA Demand signal from the control system.

This type of operation is called split range operation. For example, consider the most common split range scenario—two drives split ranged for 50% of the 4–20 mA Demand signal input. Both drives are wired in parallel to receive the same 4–20 mA signal (note that the total loop resistance should be 250 Ohms as specified by the HART® communications protocol. The 250 Ohm R11 resistor (see DCM-2 illustration on page 78) must be removed from one of the two drive DCM-2 boards to allow HART® communications. If more than two drives are split ranged, the R11 resistor must be removed from all the DCM-2 boards but one), but each drive's interpretation of the signal must be different. One drive must interpret 4–12 mA as 0–100% Demand, and one drive must interpret 12–20 mA as 0–100% Demand. This requires that the drives have different Demand signal calibrations.

Split-ranging is easily accomplished by determining the break points (12 mA in the example above) and using a HART communication device.

First, navigate to the Configuration menu. Next, select the Demand Setup submenu. Change appropriate Demand range limit accordingly. In the example above, one drive's upper Demand range (DemRngUpr) would be changed from 20.00 mA to 12.00 mA; and the other drive's lower Demand range (DemRngLwr) would be changed from 4.00 mA to 12.00 mA.

**NOTE: Ensure that the L.O.S. (Loss of Demand input signal) settings of the drives are appropriate for the new configuration. This would involve changing the appropriate Demand LOS limits (DemLimLwr or DemLimUpr). Typically, these settings are -5% and 105% of the Demand range. See page 21 for a description of the LOS function.**

# DCM-2 HART INTERFACE *Calibration - Torque Measurement*

## **TORQUE MEASUREMENT CALIBRATION**

DCM-2 boards have the capability of measuring the drive output torque and providing several torque-related features. The torque measurement is calibrated to the drive's rated output at the factory. There is normally no reason to recalibrate this feature in the field, unless a new DCM-2 board has been installed.

In the event that calibration is required, it is easily accomplished by using a HART communication device.

First, navigate to the Configuration menu. Next, select the Torque Setup submenu. Select the Trq Null parameter, which will allow the 0% torque value to be edited. Enter the number corresponding to the 0% torque value that is shown on the inside of the DCM-2 cover. Next, select the Trq Const parameter, and enter the number corresponding to the 100% torque value that is shown on the inside of the DCM-2 cover. Online help is available through the communication device.

# DCM-2 HART INTERFACE *Maintenance - Alarm Messages*

## COMMON HART® MESSAGES

HART® protocol maintains both standard and device specific informational messages that are displayed on the 275/375 Handheld Communicator when various conditions occur. They can also be used to trigger alarms and messages in other

HART® compatible monitoring systems. These messages alert the user to various alarm conditions and make it much easier to diagnose problems. Below is a table of typical Beck drive messages and message sequences. It does not include all possible messages, only the most common.

### Handswitch and Limit Switch Messages

Message	Description
"Motor power is blocked, check switches"	This message will appear if a condition prevents current flow to the motor. Some of the most common conditions are: The drive Handswitch is put in the STOP position; either of the drive over-travel limit switches are open; or the motor control triacs fail.

### Demand Signal and Process Variable Messages

Message	Description
"Process applied to the non-primary variable is outside the operating limits of the field device"	This is a standard HART®-defined message that appears whenever one of the three HART® non-primary variables (Demand signal, Torque, Temperature) are outside their design or calibrated ranges. The Demand input signal to the drive is typically the problem source; however, the message can also appear if either the torque measurement (optional) or temperature measurement is outside the design or calibrated ranges. The Beck specific messages below provide more descriptive information.
"The Demand Signal is outside of the intended limits (see Demand Setup menu)"	This is a Beck-specific message that can appear after the HART®-defined message above. It specifically pinpoints the Demand input signal to the DCM-2 as the problem source, and indicates that the signal is outside the calibrated range limits. The lower limit is configurable as a percentage of the calibrated range (default is -5%). The upper range is the highest readable input voltage (5.5 VDC) expressed as a percentage of the calibrated range (e.g., approximately 112% for a 4–20 mA* or 1–5 V dc standard input range).
"Demand out of accurate measurement range"	This is a Beck-specific message that can appear after the "Demand signal out of range" message above. It further defines the demand signal problem by indicating that the signal is not only out of the calibrated range, but also out of the design range of the drive. The lower and upper limits are 0.1 V dc and 5.55 V dc respectively.*

\*Note that current input DCM-2 boards utilize a 250 Ohm input resistor to convert the current signal to voltage.



# DCM-2 HART INTERFACE *Maintenance - Alarm Messages*

## Demand Signal and Process Variable Messages (con't)

Message	Description
"The Torque/Thrust is greater than the output rating"	This is a Beck-specific message that can appear after the HART®-defined ("Process applied to the non-primary variable is outside the operating limits of the field device") message mentioned previously. It serves to further define the condition, and indicates that the drive's torque output is exceeding 105% of the calibrated torque range of the drive.
"Motor power has been removed due to excessive output torque"	This Beck-specific message appears after the "Torque is excessive" message if the torque measurement has exceeded 150% of the calibrated range and thus gone into a protective mode of operation to prevent excessive torque in the event of an obstruction or other problem. The drive ceases driving against the load until the condition is reset. Although unlikely, it is possible to also get a "Drive in stall" message (see misc. messages) with this message.
"The temperature is outside of -40F to 185F"	This is a Beck-specific message that can appear after the HART®-defined ("Process applied to the non-primary variable is outside the operating limits of the field device") message mentioned previously. It serves to further define the condition, and indicates that the drive's internal temperature is outside the -40° to 195°F (-40° to 91°C) range.
"Demand Signal is out of limit"	The Demand Signal has exceeded its measurable limits and has entered saturation. The value reported for Demand does not reflect the actual value.
"Loop Current Detected while under HART/FF Control"	This is a Beck specific alarm message that alerts the user that analog current is present on the Demand terminals while operating the drive using the HART configurator Manual Operation menu. It is used to avoid confusion when a board is left in one of the manual operation modes and is not properly restored to "FOLLOW" mode.
"Loop Current Detected while set for LOS PAT"	PAT mode (Proportional mode) is a special Demand mode where discrete logic inputs are used in place of the Analog Demand signal. When operating in PAT mode, no Demand current should be present. If current is detected, this alarm will be asserted.

## Position Signal Messages

*(The position signal is defined as the signal from the position sensor (CPS) to the DCM-2)*

Message	Description
"Process applied to the primary variable is outside the operating limits of the field device"	This is a standard HART®-defined message that appears whenever the HART® primary variable (Position signal) is outside the design or calibrated range. The DCM-2 is designed to accept a maximum position signal range of 0.25 to 5.35 V dc, and can be calibrated anywhere within this range depending on the type of CPS and desired stroke of the drive. Normally, new drives would be calibrated for a 1–5 V dc position signal. Retrofit applications are typically calibrated for a 0.45–2.6 V dc range.

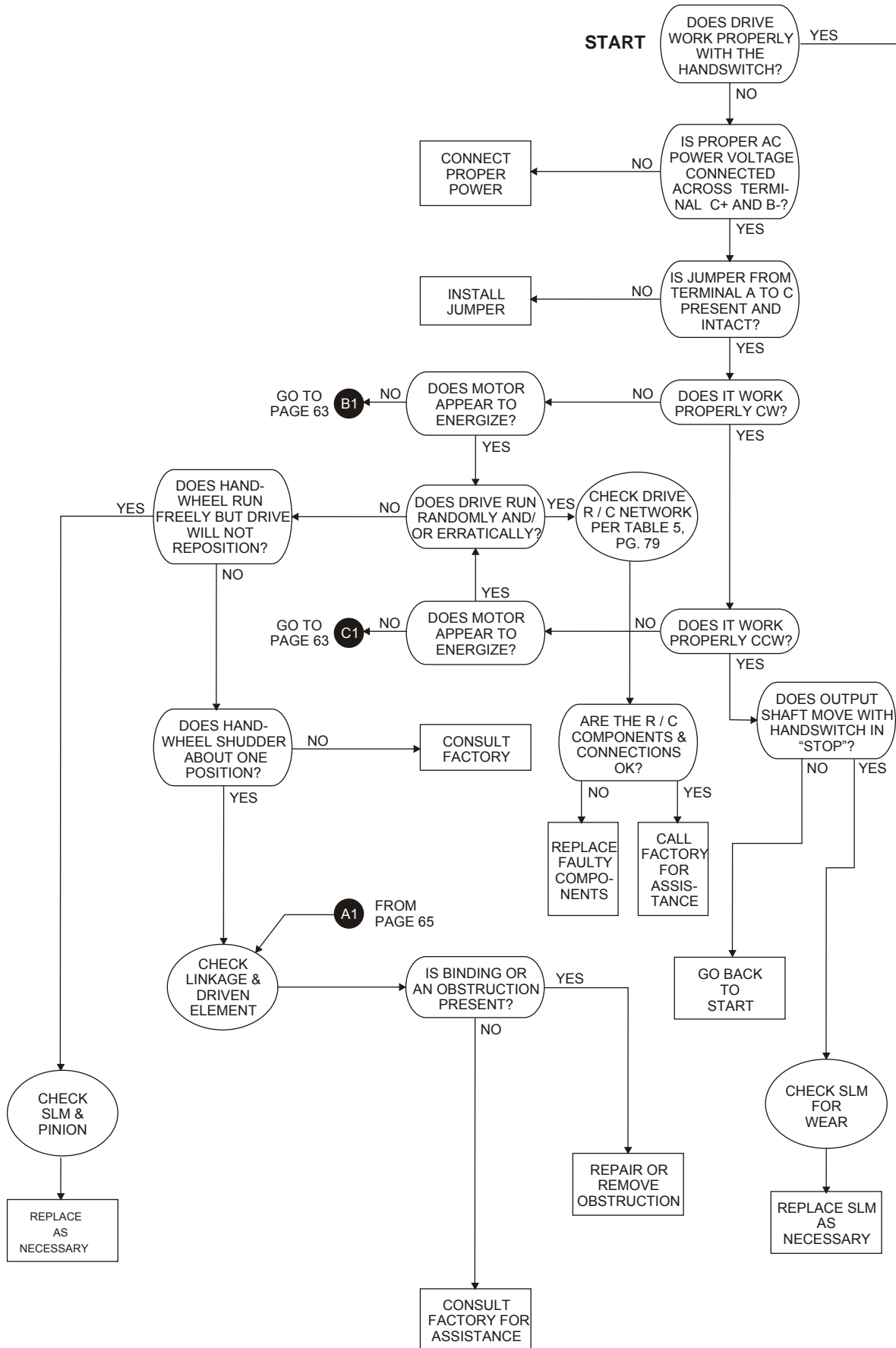
Message	Description
“Analog output 1 and its digital representation are outside the operating range limits, and not responding to input”	This is an additional standard HART®-defined message that appears whenever the HART® primary variable (Position signal) is outside the design or calibrated range. It accompanies the message above.
“The Position Signal is less than –5% or greater than 105%”	This is a Beck-specific message that appears after the HART®-defined messages above. It specifically pinpoints the position signal to the DCM-2 as the problem source, and indicates that the signal is outside the calibrated range limits. The upper and lower limits are -5% and 105% of the calibrated range respectively.
“Position signal in LOS”	This is a Beck-specific message that appears after the HART®-defined messages above. It specifically pinpoints the position signal to the DCM-2 as the problem source, and is intended to indicate a CPS or wiring failure. The message is triggered when the position signal is outside the minimum and maximum limits of 0.25 V dc and 5.35 V dc respectively. In this case, the LOS message above will also be present.
“Position out of accurate measurement range”	This is a Beck-specific message that appears after the HART®-defined messages previously mentioned. It specifically pinpoints the position signal to the DCM-2 as the problem source, and indicates that the signal is outside the 0.25–5.35 V dc design range. The LOS message above will also be present when this message is present.

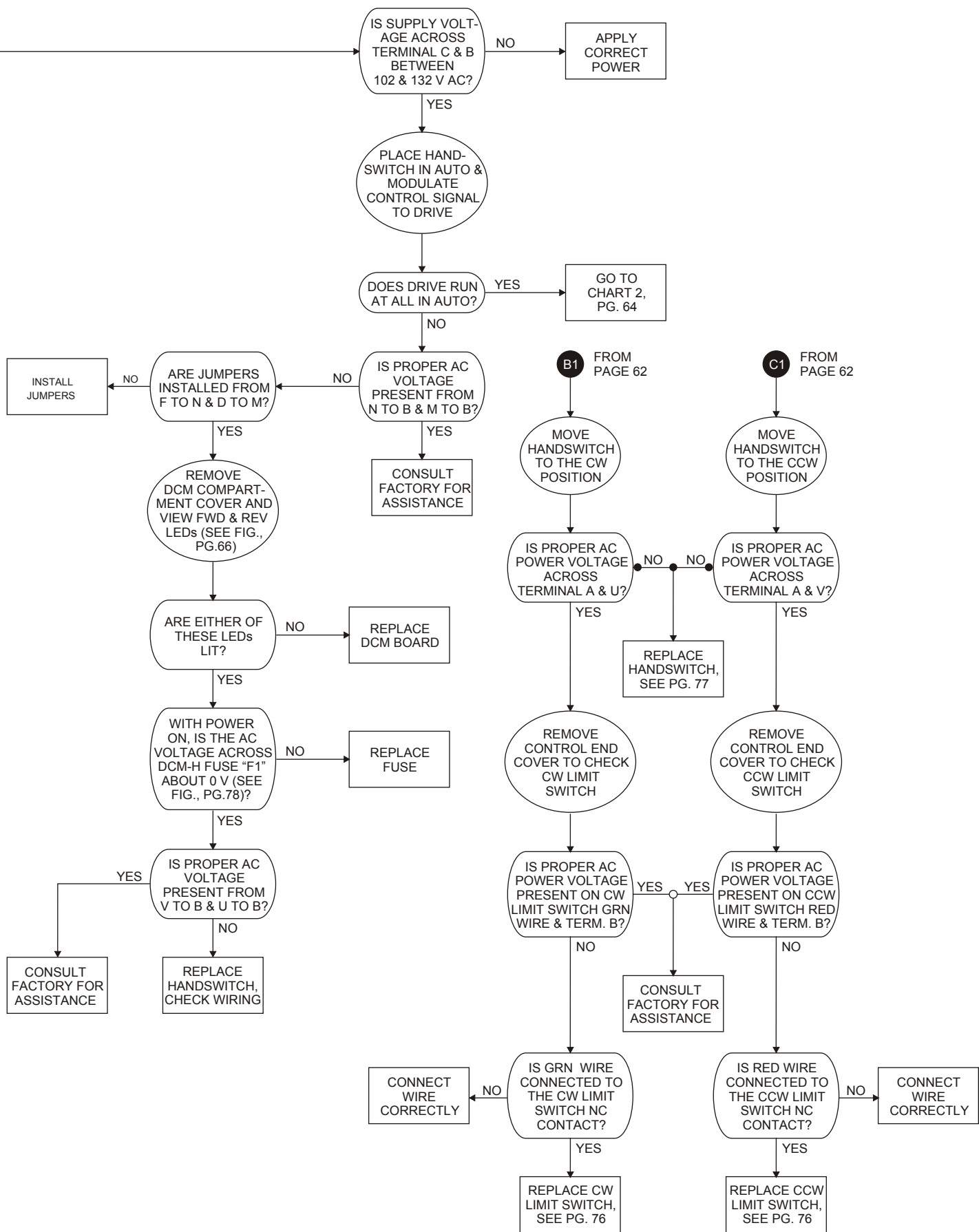
### Miscellaneous Messages

Message	Description
“The Feedback Signal is enabled but the loop is open”	This is a Beck-specific alarm message that alerts the user that external position feedback signal is installed and enabled, but not wired to an external load. If the signal is wired to an external load and this message appears, it implies that a wiring failure somewhere between the drive and the monitoring device has occurred. If the DCM-2 board is equipped with the feedback module, but the signal is not being used, this message can be eliminated by disabling the feedback in the configuration.
“Stall condition has been detected (see 'Stall Time' in the 'General Setup' menu)”	This is a Beck-specific alarm message alerting the user that the drive is in a stalled condition and is no longer trying to fight the load. This condition occurs if the drive cannot reach the demand position in the time allotted by the stall time setting (configurable from 30–300 seconds, default 300 sec.). In drives equipped with optional torque measurement, this message may not occur due to the pre-emptive action of overtorque protection.
“Feedback is in fixed mode”	The "FB Out Test" diagnostic allows the user to set Feedback to a fixed value, rather than the normal mode of having Feedback follow the Position value. If the Feedback value is left in the "fixed" mode, this error will be reported to alert the user that Feedback is not following the Position value.

# DCM-2 HART INTERFACE *Maintenance - Troubleshooting*

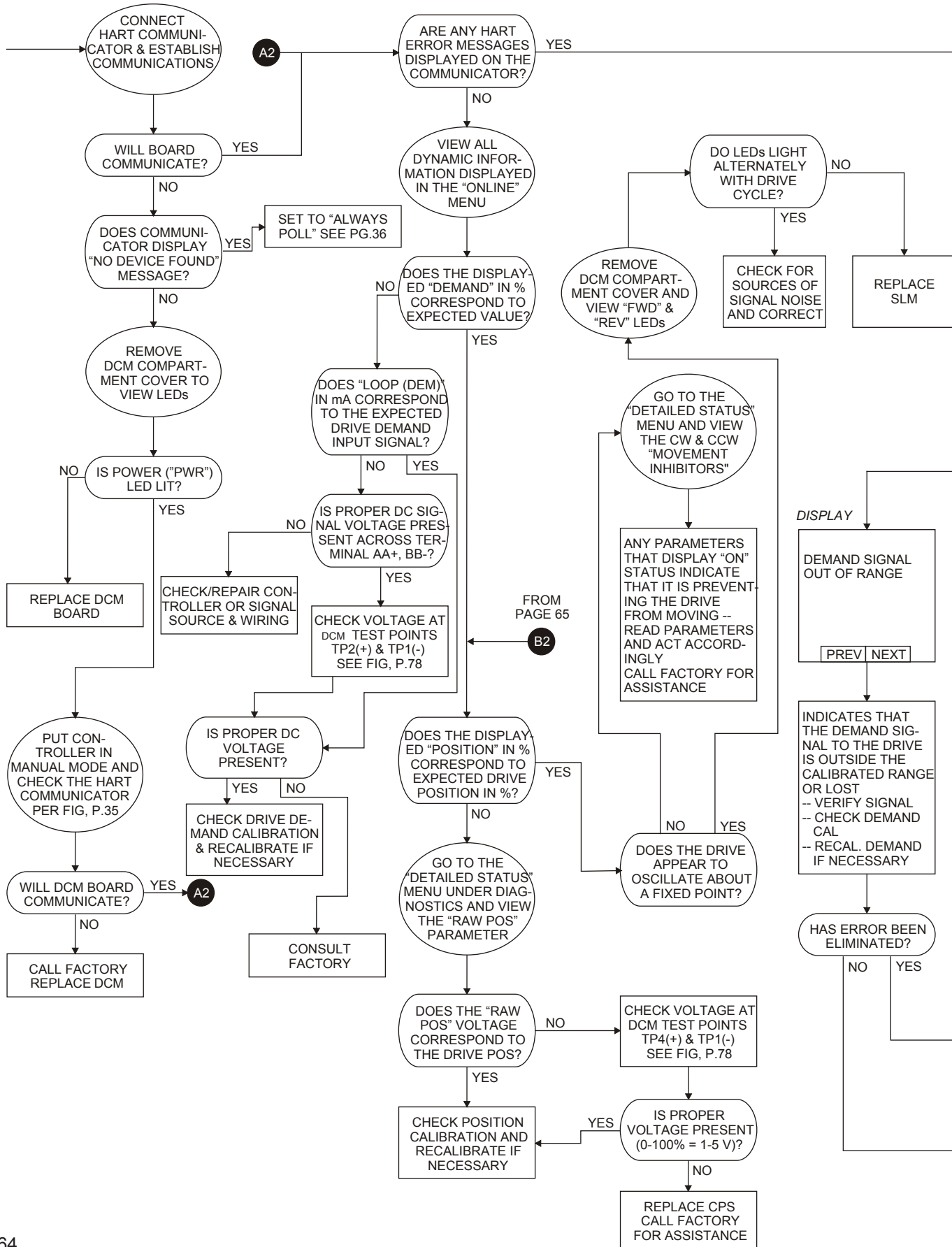
## ELECTRO / MECHANICAL -- CHART 1



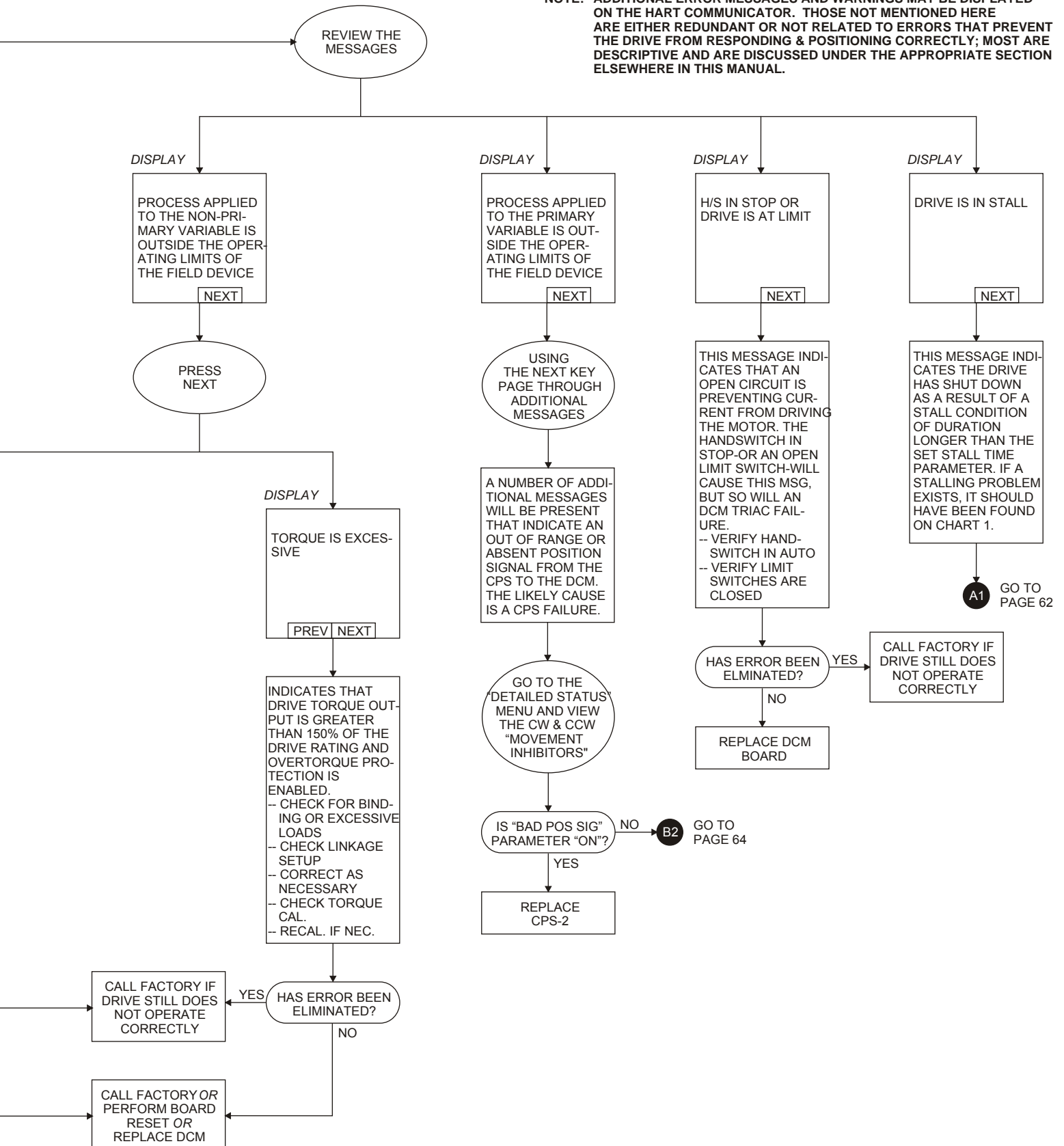


# DCM-2 HART INTERFACE *Maintenance - Troubleshooting*

## ELECTRONICS DIAGNOSTICS -- CHART 2



**NOTE: ADDITIONAL ERROR MESSAGES AND WARNINGS MAY BE DISPLAYED ON THE HART COMMUNICATOR. THOSE NOT MENTIONED HERE ARE EITHER REDUNDANT OR NOT RELATED TO ERRORS THAT PREVENT THE DRIVE FROM RESPONDING & POSITIONING CORRECTLY; MOST ARE DESCRIPTIVE AND ARE DISCUSSED UNDER THE APPROPRIATE SECTION ELSEWHERE IN THIS MANUAL.**





# DCM-2 SERIAL INTERFACE *Setup*

## COMMUNICATIONS

The Beck Digital Control Module (DCM-2) is equipped with a serial interface which allows for direct communication with a computer. Using a communication cable, connect the DCM-2 to the computer using the DCM-2's RS-232 (J20) connector (see illustration on this page) and the computer's COM port. Ensure that the COM port on the computer is active, and that the cable is plugged into the proper COM port if more than one is present (e.g., COM1, COM2, etc.). Note that a plug end adapter may be necessary for connection to the computer's COM port.

Once connected, communication can be established between the DCM-2 and the computer using a terminal emulation program, such as HyperTerminal®. This method of communication will allow for configuration, calibration and verification of drive DCM-2 settings without the use of custom software applications.

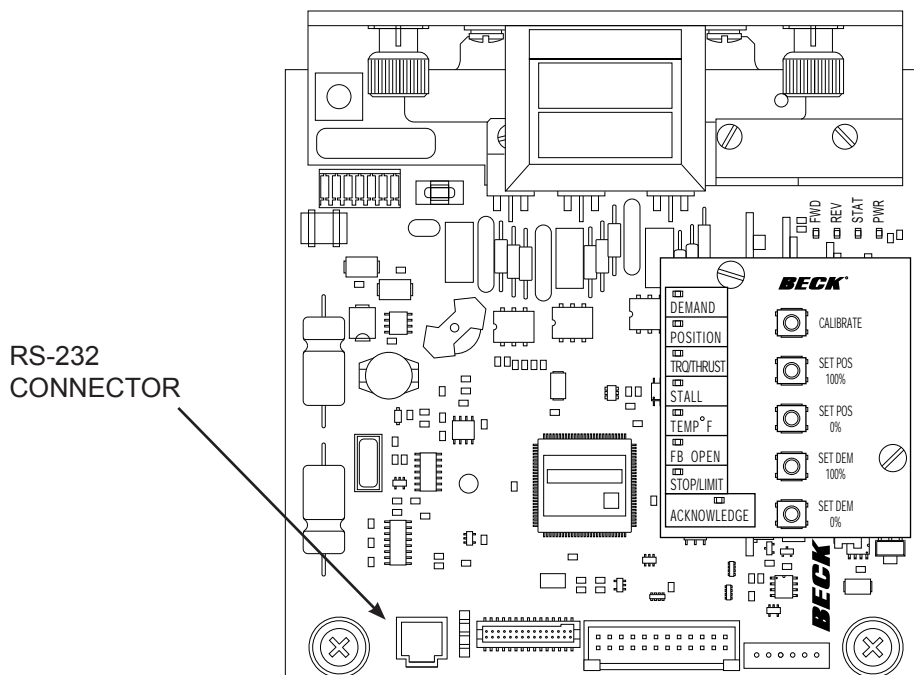
## HyperTerminal® Software

HyperTerminal is the standard ASCII terminal emulation software provided with Microsoft® Windows®. If using HyperTerminal®, the following instructions will assist in setup. Note that some variation to these instructions may be necessary depending on the version of HyperTerminal® being used.

Once the computer has been connected to the DCM-2, access HyperTerminal® by clicking first on "Start", then "Programs", then "Accessories", then "Communications", then "HyperTerminal".

Double-click on the "Hypertrm.exe" icon to start the program. Once HyperTerminal® is running, it is necessary to set up a file with the proper settings to communicate with the DCM-2. Proceed as follows:

1. If prompted to install a modem, answer "no". Proceed to enter a name (e.g., "DCM-2") and select an icon (any will suffice) in the "Connection Description" box. Click the "OK" button.
2. The "Connect to" box should open next. At the bottom of the box, set the "Connect using" selection to the computer COM port that has been connected to the DCM-2. Click the "OK" button.
3. The COM port properties box should open next. This is where the communication settings are established. The correct settings are:
  - a. Bits per second = "1200"
  - b. Data bits = "8"
  - c. Parity = "none"
  - d. Stop bits = "1"
  - e. Flow control = "none"
4. With the appropriate settings entered from Step 3, above, click "OK". Communications should now be enabled.
5. Press the "Enter" key twice. "Ok" should be displayed indicating that HyperTerminal® is



## COMMANDS AND ARGUMENTS

Commands can be used for a variety of functions including changing the operating configuration of the drive, verifying operation settings, calibration and accessing diagnostic information. There are essentially four different types of commands:

1. Dual-purpose commands. These commands can be used to either modify drive configuration settings or display the settings already set in the drive. In order to set or make a change to the settings, the command requires an argument (*n*). If the command is used for display purposes only, the argument is omitted. Examples of these commands include "dead band" and "demlos".
2. Display only commands. These commands are used to display diagnostic or operating information like present signal values. No arguments are required. Examples include the "stat" command and the "signals" command.
3. Set only commands. These commands serve only to make a parameter change. Typically, they apply to the drive calibration. This type of command requires an argument, but unlike dual-purpose commands, they return an error message when entered without an argument. Examples include the "demis" and "posis" commands.
4. Execute action commands. These commands serve to reset, enable or disable features and do not require an argument. Entering these commands produces an immediate action. Examples include the "revert" and "torqen" command.

The available commands are listed on page 68 and each is described in more detail on pages 69 through 72. The command description explains the use or uses of the command, while the argument column describes the applicable arguments for those commands that require them. In the command tables, arguments are denoted as *n*. Note that the commands described as "sets and/or displays" signify dual purpose commands that can be used with or without an argument for setting or verifying configuration settings.

# DCM-2 SERIAL INTERFACE *Commands*

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## SERIAL COMMANDS

The following is a list of serial commands available through the RS-232 interface. Error codes associated with these commands are listed on page 73.

### General Configuration Commands (p. 69)

- stepsize
- drvdir
- stalltime
- sernum

### Reset Factory Settings Commands (p. 69)

- restoremodes
- harttype

### Demand Signal Commands (p. 69 & 70)

- dem0pctma
- dem100pctma
- trimdem4ma
- trimdem20ma
- demfunc
- demlos
- demlogstp

### Position & Feedback Signal Commands (p. 71)

- posisd
- psisp
- fdbk0pctma
- fdbk100pctma
- trimfdbk4ma
- trimfdbk20ma
- fdbkfunc
- travel

### Torque Sensing Commands (p. 71 & 72)

- torq0k
- torqconst
- torq0pct
- torq100oct
- torqenable

### Diagnostic and Information Commands (p. 72)

- signals
- stat
- tempf
- torque

Note: For specific information on the following functions, see the HART interface section of the manual.

### General Configuration Commands

Command	Description	Argument <i>n</i> and Information
stepsize <i>n</i>	Sets and/or displays the size (in degrees) of one incremental movement of the output shaft.	<i>n</i> = stepsize in degrees. The minimum value that can be entered is "0.10"; which is also the standard value. The maximum value is "2.50".
drvdir <i>n</i>	Sets and/or displays the drive output shaft direction resulting from an increasing Demand signal.	<i>n</i> = "0" (indicates Extend); or <i>n</i> = "1" (indicates Retract).
stalltime <i>n</i>	Sets and/or displays the time allowed for the drive to reach its Demand target. If the drive cannot reach the target in the allotted time, a stall condition is initiated.	<i>n</i> = time in seconds. Time to stall is configurable from 30 to 300 seconds. The default value is 300 seconds.
sernum <i>n</i>	Sets the serial number of the drive in which the DCM-2 is installed. Model number information is derived from the serial number.	<i>n</i> = serial number.

### Reset Factory Settings Commands

Command	Description	Argument <i>n</i> and Information
restoremodes 1	Resets the drive configuration back to the original factory settings.	No additional argument required.
harttype <i>n</i>	Sets and/or displays the DCM-2 HART device type.	<i>n</i> = "1" (ESR-D); <i>n</i> = "10" (DCM-2); or <i>n</i> = "239" (BECK-MK2)

### Demand Signal Commands

Command	Description	Argument <i>n</i> and Information
dem0pctma <i>n</i>	Sets the Demand signal value that corresponds to 0% drive position.	<i>n</i> = the Demand signal as a decimal in milliamps. The minimum acceptable value is 0.50 mA. The maximum acceptable value is 100% Demand less 4.00 mA. For example, if the 100% Demand signal is 20.00 mA, then the 0% Demand signal must be 16.00 mA or less.

# DCM-2 SERIAL INTERFACE *Commands*

Note: For specific information on the following functions, see the HART interface section of the manual.

## Demand Signal Commands (con't)

Command	Description	Argument <i>n</i> and Information
dem100pctma <i>n</i>	Sets the Demand signal value that corresponds to 100% drive position.	<i>n</i> = the Demand signal as a decimal in milliamps. The minimum acceptable value is the Demand at 0% plus 4.00 mA. For example, if the 0% Demand signal is 4.00 mA, then the 100% Demand signal must be 8.00 mA or greater. The maximum acceptable value is 21.00 mA.
trimdem4ma 4	Calibrates the Demand signal at 4 mA. This command should only be used when the Demand signal at the drive is 4 mA. If the Demand signal at the drive is greater or less than 4 mA, an error will be returned. Note: This parameter is factory configured and normally does not require recalibration.	A 4 mA Demand signal must be present at drive terminals 14 & 15.
trimdem20ma 20	Calibrates the Demand signal at 20 mA. This command should only be used when the Demand signal at the drive is 20 mA. If the Demand signal at the drive is greater or less than 20 mA, an error will be returned. Note: This parameter is factory configured and normally does not require recalibration.	A 20 mA Demand signal must be present at drive terminals 14 & 15.
demfunc <i>n</i>	Sets and/or displays the Demand signal input characterization function. The DCM-2 provides linear, square root, special curve or square function characterization.	<i>n</i> = "0" (linear) <i>n</i> = "1" (square root) <i>n</i> = "4" (special curve) <i>n</i> = "5" (square).
demlos <i>n</i>	Sets and/or displays the Demand signal threshold below which the DCM-2 recognizes that the signal is lost. The threshold is entered as a value in mA. This command also sets and/or displays the action initiated by the drive during LOS (Loss Of Signal). LOS action options are "sip" (stay in place) or "gtp" (go to position). Note that the command always reports both settings, but only sets one argument at a time. The command must be used twice to set the threshold and action. If the action is "gtp", then the command <i>demlogtp</i> (see below) must also be set.  The option "pat" is also available to prevent error messages if the DCM-2 is not being used with a Demand signal.	<i>n</i> = the Demand signal in mA below which LOS occurs. For example, in a 4–20 mA drive, if the desired LOS is 5% below the minimum signal, then <i>n</i> = "3.20" mA. — OR — <i>n</i> = "sip", "gtp" or "pat".  Note: <i>n</i> values must be set separately.
demlogtp <i>n</i>	Sets and/or displays the position to which the drive will run upon loss of the Demand signal (LOS). This command has no effect if the drive is set to "sip" (stay in place).	<i>n</i> = the desired position of the drive expressed as a percentage of drive travel (e.g., if the desired LOS position is 50%, then <i>n</i> = "50.00").

## Position and Feedback Signal Commands

Command	Description	Argument <i>n</i> and Information
travel <i>n</i>	Sets and/or displays the value that represents 100% travel.	<i>n</i> = the desired length of travel in degrees.
fdbk0pctma <i>n</i>	Sets and/or displays the mA value of the Feedback signal that represents the 0% drive position.	<i>n</i> = the desired Feedback signal for 0% drive position in mA. The minimum value is 3 mA ("3.00") and the maximum value is at least 4 mA less than the Feedback signal value for the 100% drive position.
fdbk100pctma <i>n</i>	Sets and/or displays the mA value of the Feedback signal that represents the 100% drive position.	<i>n</i> = the desired Feedback signal for 100% drive position in mA. The minimum value must be at least 4 mA greater than the Feedback signal value for the 0% drive position. The maximum value is 21mA ("21.00").
fdbkfunc <i>n</i>	Sets and/or displays whether or not the drive Feedback signal is enabled.	<i>n</i> = "0" (no feedback) or "1" (feedback).
posis <i>n</i>	Sets the point of drive travel in relation to the drive's current position. This command should only be used when the drive is at a known position of travel.	<i>n</i> = the present drive position as a degree of full drive travel to establish where the 0% point of travel should be.
trimfdbk4ma <i>n</i>	Trims the Feedback signal at 4 mA. If the Feedback signal is not within 1 mA of 4 mA, an error will be returned. Note: The Feedback sourcing circuit is factory calibrated and normally does not require recalibration.	<i>n</i> = the present Feedback signal from the drive as measured in mA at terminals 16 & 17. The minimum value is 3 mA ("3.000") and the maximum value is 5 mA ("5.000").
trimfdbk20ma <i>n</i>	Trims the Feedback signal at 20 mA. If the Feedback signal is not within 1 mA of 20 mA, an error will be returned. Note: The Feedback sourcing circuit is factory calibrated and normally does not require recalibration.	<i>n</i> = the present Feedback signal from the drive as measured in mA at terminals 16 & 17. The minimum value is 19 mA ("19.000") and the maximum value is 21 mA ("21.000").

## Torque Sensing Commands

Command	Description	Argument <i>n</i> and Information
torq0k <i>n</i>	Assigns the count value to be associated with 0 torque. This number is unique to each drive.	<i>n</i> = the zero torque value in counts. This number is determined during manufacture and is noted on a tag affixed to the drive body within the electronics compartment.



# DCM-2 SERIAL INTERFACE *Commands*

Note: For specific information on the following functions, see the HART interface section of the manual.

## Torque Sensing Commands (con't)

Command	Description	Argument <i>n</i> and Information
torqconst <i>n</i>	Assigns the count value to be associated with the torque span. This number is unique to each drive.	<i>n</i> = the torque span value in counts. This number is determined during manufacture and is noted on a tag affixed to the drive body within the electronics compartment.
torqenable <i>n</i>	Enables or disables the torque measurement feature of the drive.	<i>n</i> = "0" (disabled) or "1" (enabled).

## Diagnostic and Information Commands

Command	Description	Argument <i>n</i> and Information
signals	Displays the present Position signal of the drive in volts and the Demand signal in milliamps.	No argument.
stat	Displays information on the status of the drive, including: Time / Date Demand (% and settings) Position (% / inches) Error (%) Stepsize (inches / %) Deadband (inches / %) Motor Status Run Time Line Frequency Starts (ext./ret./total) Reversals/Stalls Overloads Positive & Negative Peak Load (%) Positive & Negative Peak Torque (% / inches) Extend and Retract Inhibit Setting Alarms	No argument.
tempf	Displays measured temperatures in the drive (°F.): Low extreme Present temperature High extreme	No argument.
torq	Displays the drive's present torque measurement as a percentage of rated torque.	No argument.

# DCM-2 SERIAL INTERFACE *Command Error Codes*

## Command Error Codes

When an error is encountered using the serial commands, an "ERROR XX" message is returned. The table below provides a description of the error codes ("XX").

Code	Description	Information
2	Invalid selection	Displayed when an unknown command has been entered.
3	Value too big	Displayed when an entered numeric value exceeds expected parameters.
4	Value too small	Displayed when an entered numeric value is less than expected parameters.
5	Data length error	Displayed when the wrong number of arguments is entered.
6	General error	Displayed when a combination of circumstances prevents a better description of the error.
9	Process too high	Displayed when the entered value exceeds acceptable parameters when calibrating a 0% value.
10	Process too low	Displayed when the entered value is less than acceptable parameters when calibrating a 100% value.
14	Span too small	Displayed when entered values for a 0% point and a 100% point are too close.
32	Busy	Displayed when a memory store is requested and another memory store is already in process.
64	Not implemented	Displayed when an entered command is defined, but cannot be implemented.

# MAINTENANCE *ROUTINE*

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Beck drives require only a minimum of routine maintenance. A visual inspection is in order to verify that the connection to the final control element is intact and operating normally. If vibration is present, check the electrical terminal connections and other hardware for tightness.

## LUBRICATION

Periodic lubrication is not required on Beck control drives. However, it is recommended that during major shutdowns or outages, the drives in the most severe applications be inspected to determine the need to relubricate the drive gear train.

If your drive has a linkage, to extend the life of the linkage rod ends, they should be included in your scheduled lubrication program.

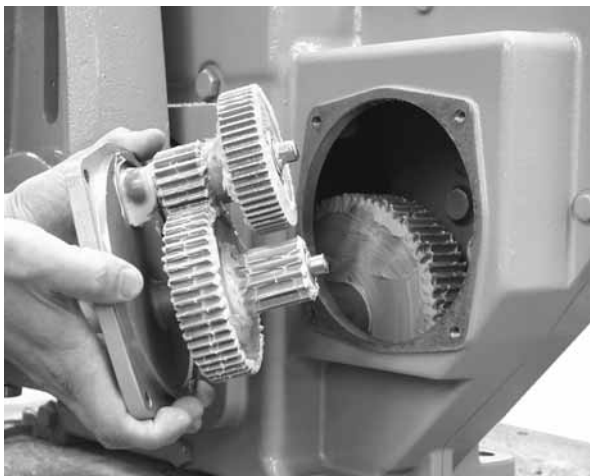
### CAUTION

**If your drive has a linkage, before removing the gear module assembly, block the control drive crank arm to prevent the crank arm and the gear train from moving when the change module is removed.**

To inspect the gears, remove the gear module assembly on the 11-209/-269, -309/-369 and -409/-469. On Model 11-159/-169, the motor must be removed to access the gears. Clean the gears thoroughly, removing all old lubrication.

Examine the gear teeth, shaft bore, and gear shafts for signs of excessive wear, scoring, or other damage. If evidence of this damage is present, the drive should be returned to the factory for a detailed examination of the main gear, which requires complete disassembly of the drive. See "HOW TO OBTAIN SERVICE" on page 87.

If there is no evidence of damage to the gearing, recoat the teeth and shaft bores of all gears with a heavy layer of Fiske Lubriplate GR-132 or equivalent (GR-132 is an E.P. grease with polymer additives). The ball bearing on the output shaft and crown gear shaft have added double grease seals and require no maintenance for the life of the bearings. Inspect all grease seals and replace any that show wear. Reassemble the drive, referencing pages 8–14 for appropriate bolt torques.



**11-409 Gear Module**

# MAINTENANCE **COMPONENT REPLACEMENT** \_\_\_\_\_

This section covers replacement of many components of the drive. Note that some components are not field-repairable. Refer to the drive outline dimension drawings on pages 8–14 and to the cutaway illustration on page 4 for location of components on the drive.

If it should ever be necessary to replace the output gear, shaft, or output shaft bearings, a major overhaul is required and the drive should be returned to the factory. During a major overhaul, the factory repair department will update the drive to include all possible engineering improvements. See "HOW TO OBTAIN SERVICE" on page 87.

## GASKETS

During routine service, inspect the cover, motor, and change gear plate gaskets for wear or damage. In order to protect internal components, worn or damaged gaskets and O-rings should be replaced.

To remove, scrape all of the old adhesive and gasket material from the body housing and cover. Cement the new gasket to the drive body using a gasket cement such as 3M #847 Rubber and Gasket Adhesive, or equivalent.

## SEALS

Worn or damaged output shaft, control end shaft, and motor shaft seals should be replaced to prevent damage to internal bearings and drive train parts.

To remove the shaft seal, push the blade of a small screwdriver along the shaft and under the seal lip. **CAUTION:** The seal is approximately 1/4" (6 mm) wide. Do not force the screwdriver blade beyond the width of the seal; damage to the shaft bearing could result. Pry up on the seal and force it out of the housing. Clean the shaft and housing then press in the replacement seal with the closed side facing outward.

## BEARINGS

The Beck control drive contains ball bearings on the output shaft, control end shaft, and motor shaft. Bushings and thrust washers are used on combination gears. Field replacement of these components is not recommended.

Motor shaft bushings in the body of the 11-159/-169 and 11-409/-469 can be replaced. **TIP:** To remove, fill the bushing with a heavy grease. Select a drive pin that slip fits into the bushing. Insert the pin into the bushing and tap with a mallet. This will force the bushing out of the body casting.

## MOTOR

The control motor is not field-repairable. Disassembly of the motor will result in a loss of torque that can only be restored by returning the motor to the factory for re-magnetizing.

### CAUTION

**If your drive has a linkage, before removing the control motor, block the control drive crank arm to prevent the crank arm and the gear train from moving when the motor is removed.**

To remove the motor, first disconnect the motor wires in the terminal compartment of the control drive.

In the 11-159/-169 drives, the Handswitch must first be removed from the body before removing the terminal block and plate as an assembly. Follow the instructions in the paragraphs below.

In the 11-209/-269, -309/-369, and -409/-469 drives, remove the terminal block and plate as an assembly. Remove the black wire from the terminal post, cut the red motor wire near the red-yellow-red butt joint and disconnect the green wire from the motor capacitor. Remove the mounting bolts and motor. Carefully slide the motor out of the drive body.

To install the motor, insert the three-wire sleeve through the wire hole in the motor mount and into the terminal compartment. Carefully slide the motor into the drive body. Rotate the motor shaft, if necessary, to engage the pinion with the first combination gear. Install motor mounting bolts and torque to recommended values. See pages 8–14 for torque values. Reconnect the motor wires. See the following section for reinstalling the terminal plate.

## Motor Resistor and Capacitor

The motor resistor and capacitor are located under the terminals in the terminal compartment. To replace a resistor or capacitor, remove the terminal cover.

In the 11-159/-169 drives, the Handswitch must first be removed from the body before removing the terminal block and plate as an assembly. Follow the instructions in the following paragraph.

In the 11-209/-269, -309/-369, and -409/-469, remove the terminal plate. Remove the existing part and transfer the wires one at a time to the replacement part. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft (4 N•m).

# MAINTENANCE *COMPONENT REPLACEMENT*

## OVER-TRAVEL LIMIT AND AUXILIARY SWITCHES

Complete switch assemblies may be replaced. It is not possible to replace individual switches. To replace switch assemblies, remove the control end cover (1/2" bolt heads) and extensions, if applicable. Remove the screws holding the switch assembly to the plate and slide it out to the side.

Transfer the wires one at a time to the replacement assembly using the push-on lugs provided. Install the replacement assembly and note that it rotates around one screw to permit an adjustment of the cam-to-switch lever spacing and switch operating point. To set the switch, place a .030" (.75 mm) shim between the cam and switch lever. The switch lever should be on the low or minimum radius portion of the cam when setting the switches. Position the switch assembly so that the switch is just actuated. DO NOT overstress the switch lever. Tighten both screws to 10 lb-in (14 N•m) torque and remove the shim. When properly adjusted, the switch lever should remain in contact with the cam throughout the control drive travel.

## Adding Switches

It is usually possible to add switches to a control drive in the field. Remove the control end cover (1/2" bolt heads). If the drive has no auxiliary switches, it is possible to add up to four switches. See Table 4, page 79, for switch assembly part numbers.

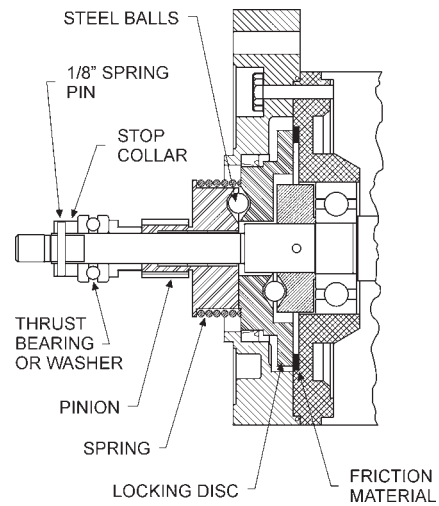
Install wiring onto the switch push-on lugs and route the wires into the control drive terminal area. Remove the terminal cover and solder wires to the underside of the terminal assembly according to the wiring diagram included with the new switch assembly. Install the new switch assembly and adjust according to the preceding instructions.

## SELF-LOCKING MECHANISM (SLM)

In normal service, the SLM friction surface should not require replacement; however, a combination of excessive modulation and load can cause wear to the SLM mechanism. If the SLM has been damaged, rebuild kits are available (see Table below).

SLM Rebuild Kits typically consist of friction material, spring, spring pin, thrust washer, pinion, steel balls, locking disc, steel shims, control motor gasket, terminal joints, slip-on terminal and instruction sheet.

See the illustration below for component identification.



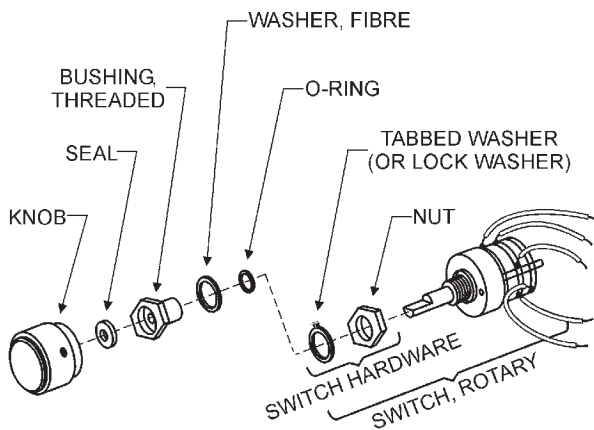
**TABLE 3:  
SLM PART NUMBERS**

Motor Part Number	SLM Rebuild Kit	Instruction Sheet
<u>11-159/-169</u> 20-2700-20 20-2701-20	12-8060-15 12-8060-16	80-0016-05 80-0016-05
<u>11-209/-269, -309/-369</u> 20-2704-21 20-2705-21	12-8060-17 12-8060-18	80-0016-07 80-0016-07
<u>11-409/-469</u> 20-2201-21, -22, -23 20-2201-31, -32, -33	12-8060-11 12-8060-13	80-0016-01 80-0016-02

## HANDSWITCH

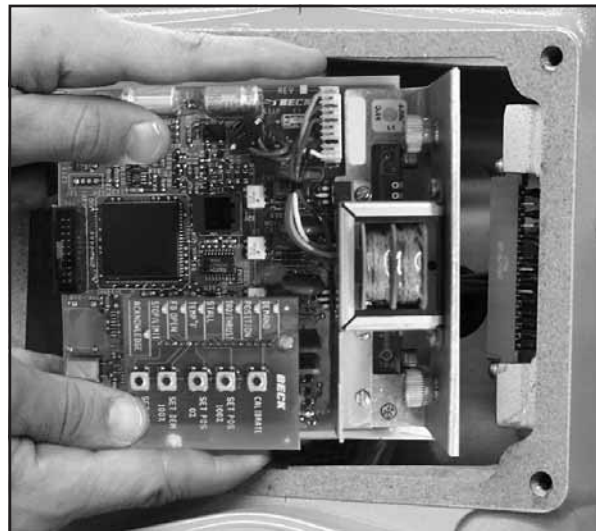
To replace the Handswitch, remove the terminal cover, and then remove the terminal plate (11-209/-269, -309/-369, and -409/-469 only). Clip the five wires from the old Handswitch. Remove the knob and the nut under the knob to remove the switch. Install the new Handswitch as shown below. Splice the wires color for color. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and the gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft (4 N•m). Do not over-torque. Replace the terminal cover. Torque bolts to 10 lb-ft (14 N•m).

**NOTE:** When the Handswitch is turned fully clockwise, “AUTO” should be indicated.



## DCM-2 BOARD

Field service of the DCM-2 board is not recommended. The factory maintains a stock of replacement boards for immediate shipment. To replace the DCM-2 board, remove the Digital Control Module compartment cover (1/2" bolt heads). If applicable, disconnect the torque sensing wires from the bottom of the customer interface panel by gently pulling on the connector. Loosen the four captive screws holding the board to its mounting pads. Note the “L” shaped mounting bracket on the end of the board. To remove the board, pull the mounting bracket away from its mating surface. See illustration below.



To install a DCM-2 board, lightly press the board connector into its receptacle until the mounting bracket is flush with its mating surface. Tighten the four captive screws to 8 lb-in (.9 N•m). If applicable, connect the torque sensing wires to the bottom of the customer interface panel by gently pressing the connector into its receptacle. Replace the compartment cover. Torque cover bolts to 10 lb-ft (14 N•m).

## CPS-2

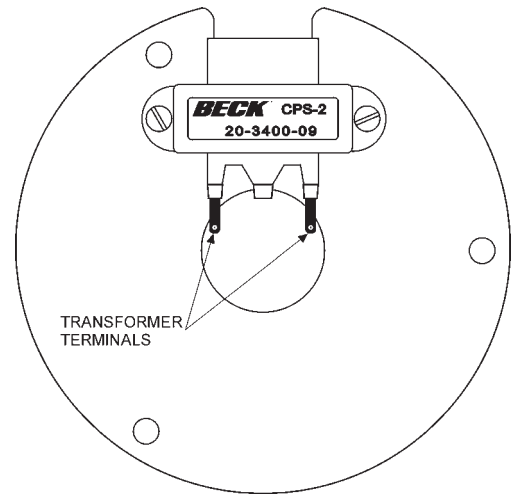
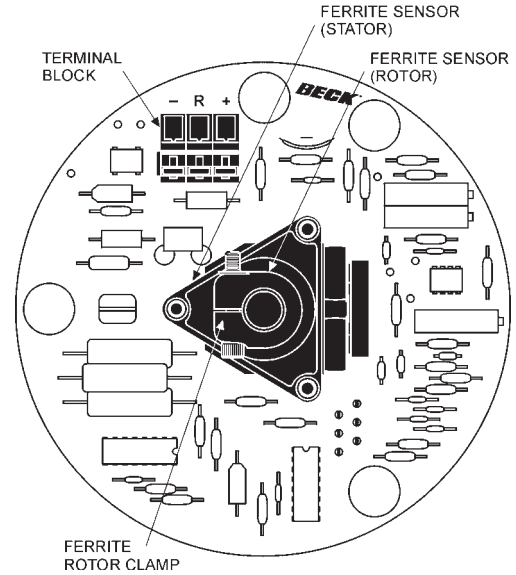
Field repair of the CPS-2 assembly is not recommended. The factory maintains a stock of replacement assemblies for immediate shipment. If it is necessary to replace the CPS-2, replace both the rotor and stator / circuit board assembly. When returning the CPS-2 to the factory for service, include the rotor and stator / circuit board assembly. Do not separate the stator or circuit boards from their mounting plates. The rotor should be held inside the stator with rubber bands for protection during shipment.



# MAINTENANCE *COMPONENT REPLACEMENT*

## To remove the CPS-2:

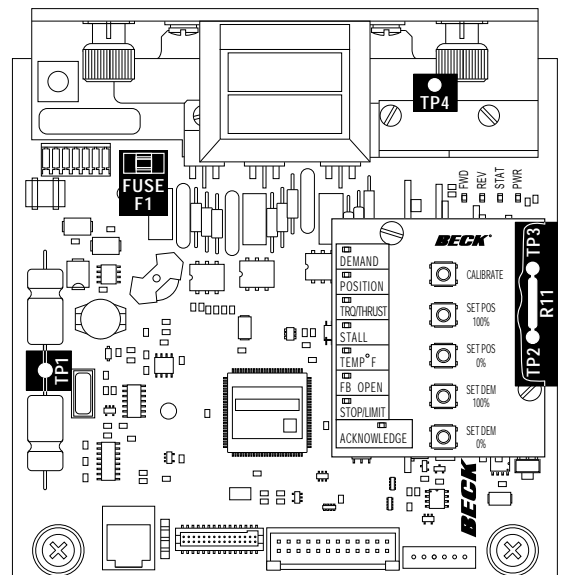
1. Run the control drive to its midpoint of travel with the local Handswitch. (If the standard rotation of 100° has been reduced to 80°, the midpoint of travel is 40°.)
2. Disconnect 120 V ac power to the drive. Remove the terminal, DCM-2 compartment and control end covers (1/2" bolt heads).
3. Record the wire colors on the terminal block of the CPS-2 (see illustration at right), then disconnect the wires. The terminals are spring-loaded. To remove a wire, press the tip of a small screwdriver into the slot at the top of the small lever. Push down to open the spring-loaded contact and release the wire.
4. Pull the wires from the transformer (see illustration at right) back through the wire hole in the CPS-2.
5. Loosen and remove the 3 hex studs that clamp the CPS-2 in place. Ensure that the inboard hex stud is not loosened as the outboard stud is loosened.
6. Slide the CPS-2 stator assembly off the three mounting bolts.
7. Note the position of the rotor clamp, then loosen the rotor clamp screw and remove the rotor from the shaft.



CPS-2 Components

## To install the new CPS-2:

1. Remove the rotor from the replacement CPS-2 assembly. Slide the rotor, clamp end first, onto the control shaft as close to the mounting plate as possible. Leave the clamp loose. Position the clamp in the same general location as the one removed previously.
2. Slide the new CPS-2 assembly over the studs and rotor. Replace the hex nuts but do not tighten. Carefully slide the rotor back into the CPS-2 assembly. Twist the rotor while sliding to prevent damage to the assembly. Tighten hex nuts to 5 lb-ft (7 N•m).
3. Thread the wires through the wire holes in the CPS-2 and reconnect them to the transformer and terminal block.
4. Restore 120 V ac power to the drive and connect a meter to the output.
5. Insert a 0.031" (.80 mm) feeler gauge between the rotor clamp and stator. Position the clamp 0.031" (.80 mm) from the stator.
6. Rotate the rotor (only a minor adjustment should be necessary) on the control shaft until the output voltage measured across TP4 and TP1 (see illustration at right) reads 50% (approx. 3 volts) of the signal span. Tighten clamp to 5 lb-in (.6 N•m) torque.
7. Perform a position calibration procedure as described on page 30 or page 54.



Location of DCM-2 Test Points and Resistor

# APPENDIX SPARE PARTS

## RECOMMENDED SPARE PARTS

It is recommended that certain replacement parts be stocked for quick availability in the event that service of your Beck control drive is required. The types of parts are listed in Table 4, below.

## HOW TO ORDER SPARE PARTS

Select the needed parts from the spare parts list given below. Specify the drive's model / serial number (e.g., 11-309-031891-01-02) given on the nameplate to allow the factory to verify the part selection. Parts may be ordered by mail, telephone or fax, with the confirming order sent to the factory (see back cover).

**TABLE 4: RECOMMENDED SPARE PARTS**

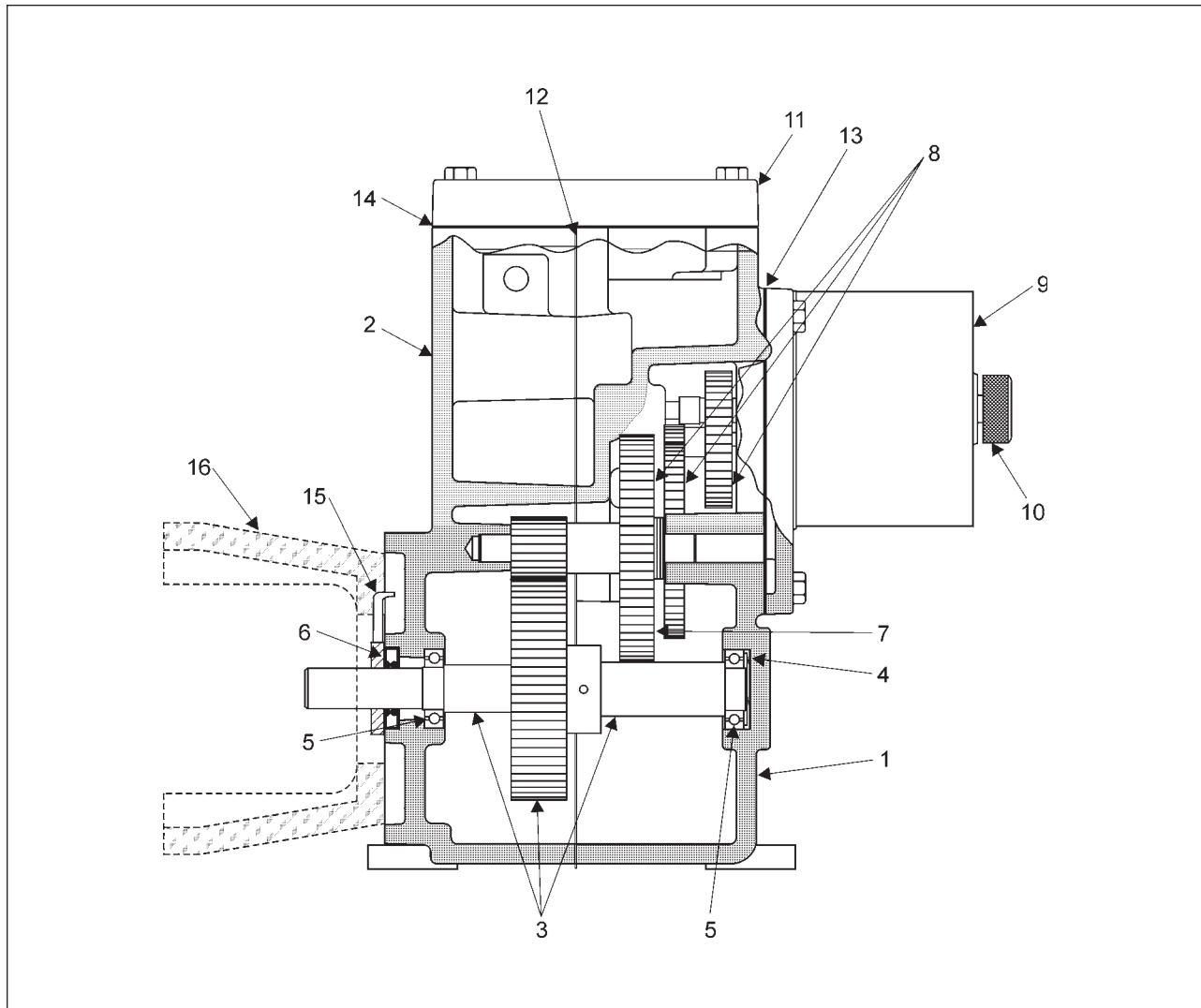
DESCRIPTION	PART NO.	DESCRIPTION	PART NO.
Limit switch assembly	20-3202-10	Control motor	See Table 5, below
Auxiliary switch assembly (2 switches)	20-3202-11	Motor resistor	See Table 5, below
(4 switches)	20-3202-12	Motor capacitor	See Table 5, below
Gasket set:		DCM Board	22-5012-59
Model 11-159, -169	20-3110-01	Fuse, 7A, 125V	11-1373-01
Model 11-209, -269	20-3110-02	CPS-2	20-3400-09
Model 11-309, -369	20-3110-02		
Model 11-409, -469	20-3110-03		

**TABLE 5: MOTORS, CAPACITORS AND RESISTORS**

USED ON MODEL NO.	MOTOR PART NO.	VOLTAGE	HERTZ	AMP.	CAPACITOR PART NO.	VALUE	RESISTOR PART NO.	VALUE
11-159/-169	20-2700-20	120	60	.17	14-2840-02	2 µf	11-5802-03	500Ω
			50	.17	14-2844-13	3 µf	11-5802-03	500Ω
	20-2701-20	120	60	.32	14-2844-11	4 µf	11-5802-02	475Ω
			50	.32	14-2840-11	4 µf	11-5802-02	475Ω
11-209/-269 and 11-309/-369	20-2704-21	120	60	.35	14-2844-16	5 µf	20-1971-13	220Ω*
			50	.35	14-2844-19	7 µf	20-1971-13	220Ω*
	20-2705-21	120	60	.56	14-2844-05	8 µf	20-1971-12	110Ω*
			50	.56	14-2844-06	10 µf	20-1971-12	110Ω*
11-409/-469	20-2201-31	120	60	1.25	14-2844-17	15 µf	20-1971-03	75Ω*
			50	1.25	14-2844-16	5 µf	20-1971-03	75Ω*
					14-2844-17	15 µf		
	20-2201-32	120	60	2.20	14-2844-15	25 µf	20-1971-04	37.5Ω*
			50	2.20	14-2844-05	8 µf	20-1971-04	37.5Ω*
					14-2844-15	25 µf		
	20-2201-33	120	60	3.00	14-2844-15	25 µf	20-1971-06	18Ω*
						14-2844-09	6 µf	
			50	3.00	14-2844-15	25 µf	20-1971-10	24Ω*
						14-2844-05	8 µf	
				14-2844-09	6 µf			

\*This is a resistor assembly.

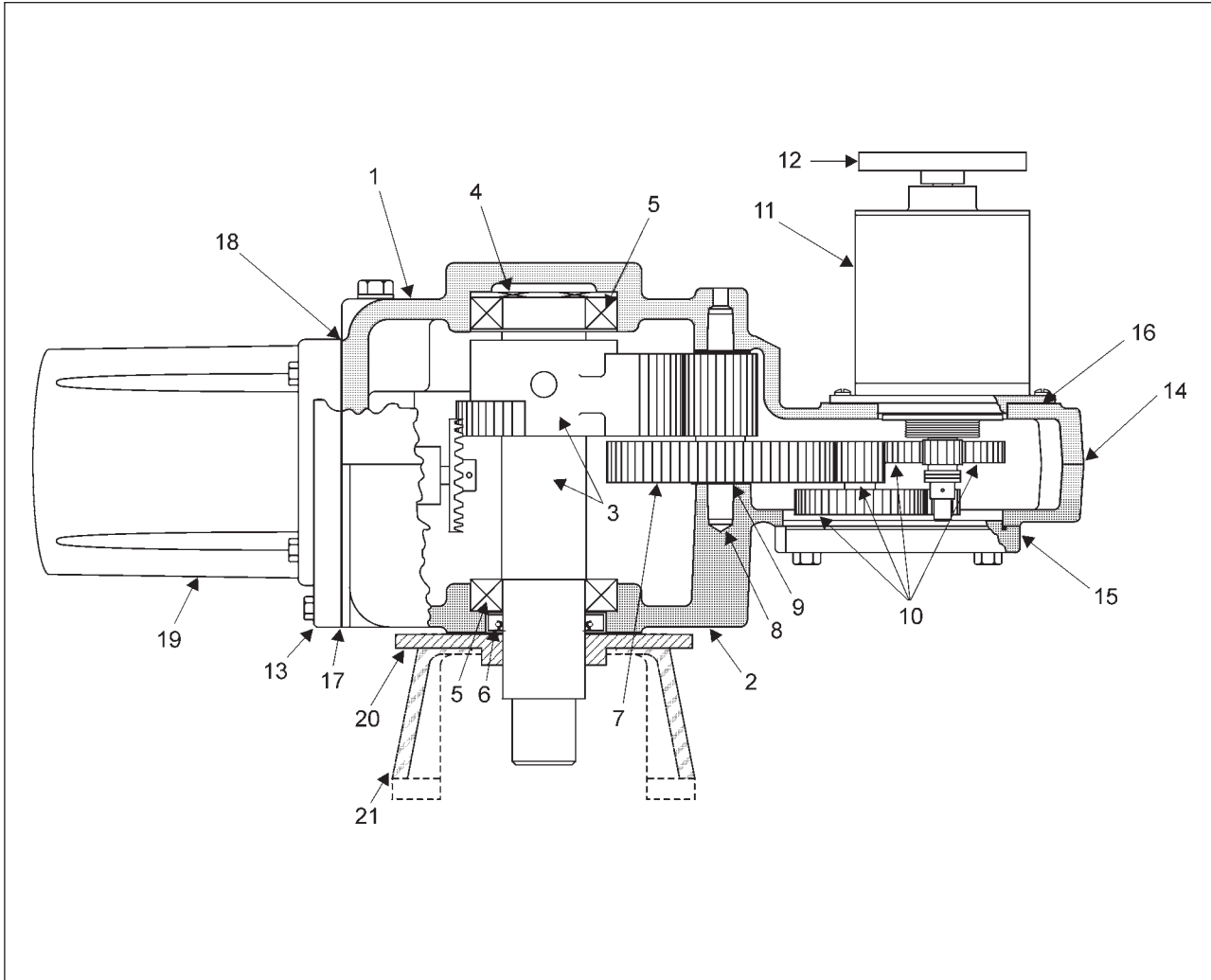
# APPENDIX COMPONENTS



**TABLE 6:  
DRIVE COMPONENTS FOR MODEL 11-159 / -169**

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	11	Terminal / DCM compartment cover
2	Body front	12	Gasket, body
3	Output shaft assembly and main gear	13	Gasket, control motor
4	Spring washer	14	Gasket, terminal cover
5	Ball bearing, output shaft		Gasket, DCM cover
6	Seal, output shaft		Gasket, control end cover
7	Gear, 3rd combination		Control end cover
8	Gear module assembly, see Table 9, page 88, for part number		Control end cover extension
9	Control motor, see Table 5, page 84, for part number		Terminal block
10	Handwheel		Barrier, insulator, terminal compartment
		15	Index pointer (-159 only)
		16	Bracket (-169 only)

Note: To ensure exact replacement parts, include all nameplate data of the Beck drive with the order.

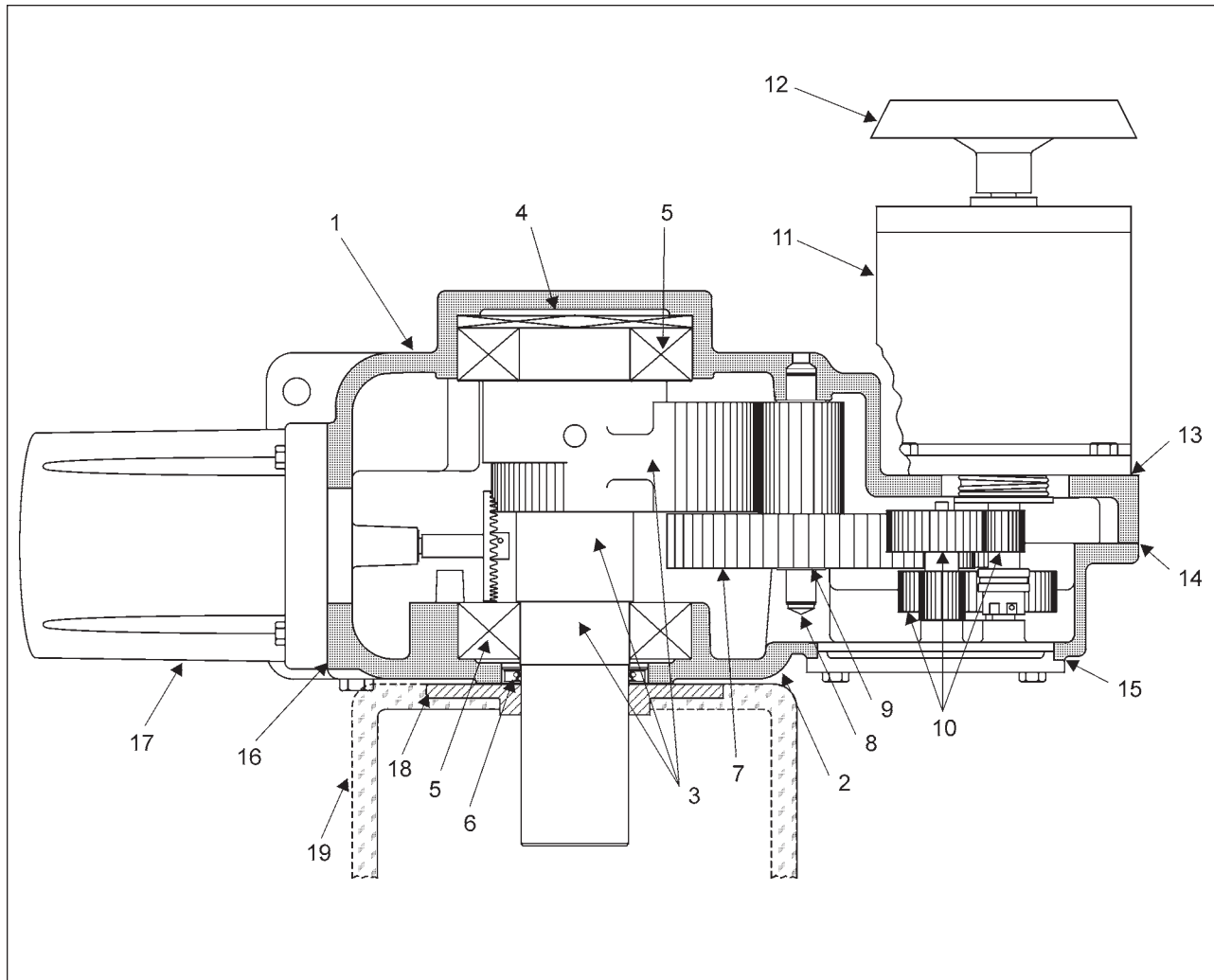


**TABLE 7:  
DRIVE COMPONENTS FOR MODEL 11-209 / -269 / -309 / -369**

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	13	Terminal / DCM compartment cover
2	Body front	14	Gasket, body
3	Output shaft assembly and main gear	15	Gasket, gear module
4	Spring washer	16	Gasket, control motor
5	Ball bearing, output shaft	17	Gasket, DCM & terminal cover
6	Seal, output shaft	18	Gasket, control end cover
7	Gear, 3rd combination	19	Control end cover
8	Pin, 3rd combination gear		Control end cover extension
9	Thrust washer		Terminal block
10	Gear module assembly, see Table 9, page 88, for part number		Barrier, insulator, terminal compartment
11	Control motor, see Table 5, page 84, for part number		Barrier plate
12	Handwheel		Gasket, barrier plate
		20	Index (-209 / -309 only)
		21	Bracket (-269 / -369 only)

Note: To ensure exact replacement parts, include all nameplate data of the Beck drive with the order.

# APPENDIX COMPONENTS



**TABLE 8:  
DRIVE COMPONENTS FOR MODEL 11-409 / -469**

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	12	Handwheel
2	Body front	13	Gasket, control motor
3	Output shaft assembly and main gear	14	Gasket, body
4	Spring washer	15	Gasket, gear module
5	Ball bearing, output shaft	16	Gasket, control end cover
6	Seal, output shaft	17	Control end cover
7	Gear, 3rd combination		Control end cover extension
8	Pin, 3rd combination gear		Terminal block & barrier plate
9	Thrust washer		Gasket, barrier plate
10	Gear module assembly, see Table 9, page 88, for part number		DCM & terminal compartment cover
11	Control motor, see Table 5, page 84, for part number		Gasket, DCM & terminal cover
			Barrier, insulator, terminal compartment
		18	Index (-459 only)
		19	Bracket (-469 only)

Note: To ensure exact replacement parts, include all nameplate data of the Beck drive with the order.

**TABLE 9:  
GEARS, TORQUE AND TIMING OPTIONS**

Drive Model Number	Approx. Weight	Maximum Overhung Load	Motor Part Number	Motor Current @ 120 V ac, 60 Hz*	Gear Module Number	Torque	Models -159 & -_09 Timing (sec/100°) @ 60 Hz**	Models -_69 Timing (sec/90°) @ 60 Hz**
11-159	50 lbs (23 kgs)	750 lbs (340 kgs)	20-2700-20	.17	14-9733-01	80 lb-ft (108 N·m)	90	81
11-169	56 lbs (25 kgs)				14-9733-02	60 lb-ft (81 N·m)	60	54
					14-9733-03	40 lb-ft (54 N·m)	40	36
					14-9733-04	20 lb-ft (27 N·m)	20	18
11-169	56 lbs (25 kgs)	20-2701-20	.32	14-9733-03	80 lb-ft (108 N·m)	40	36	
				14-9733-04	40 lb-ft (54 N·m)	20	18	
				14-9733-05	15 lb-ft (20 N·m)	11	10	
11-209	120 lbs (54 kgs)	3,000 lbs (1 361 kgs)	20-2704-21	.35	14-9730-04	125 lb-ft (169 N·m)	40	36
11-269	115 lbs (52 kgs)				14-9730-05	175 lb-ft (237 N·m)	60	54
					14-9730-08	250 lb-ft (339 N·m)	75	68
11-269	115 lbs (52 kgs)		20-2705-21	.56	14-9730-02	125 lb-ft (169 N·m)	20	18
		14-9730-04			250 lb-ft (339 N·m)	40	36	
11-309	125 lbs (57 kgs)	4,500 lbs (2 041 kgs)	20-2704-21	.35	14-9730-09	300 lb-ft (407 N·m)	100	90
11-369	115 lbs (52 kgs)		20-2705-21	.56	14-9730-04	300 lb-ft (407 N·m)	40	36
					14-9730-05	400 lb-ft (542 N·m)	60	54
					14-9730-08	550 lb-ft (746 N·m)	75	68
11-369	115 lbs (52 kgs)	20-2705-21	.56	14-9730-09	650 lb-ft (881 N·m)	100	90	
11-409	270 lbs (122 kgs)	9,000 lbs (4 082 kgs)	20-2201-21, -31	1.25	14-9732-02	800 lb-ft (1 085 N·m)	60	54
11-469	216 lbs (98 kgs)				14-9732-03	1,500 lb-ft (2 034 N·m)	100	90
					14-9732-04	1,000 lb-ft (1 356 N·m)	75	68
					14-9732-05	350 lb-ft (475 N·m)	24	22
			14-9732-07	550 lb-ft (746 N·m)	40	36		
11-469	216 lbs (98 kgs)		20-2201-22, -32	2.20	14-9732-02	1,800 lb-ft (2 440 N·m)	60	54
					14-9732-05	650 lb-ft (881 N·m)	24	22
					14-9732-07	1,000 lb-ft (1 356 N·m)	40	36
		14-9732-02			1,800 lb-ft (2 440 N·m)	36	32	
11-469	216 lbs (98 kgs)	20-2201-23, -33	3.00	14-9732-07	1,000 lb-ft (1 356 N·m)	24	22	

CAUTION: Use only the motor and gear housing combinations listed above; other combinations may cause internal damage to the drive and/or damage to external equipment.

\* 50 Hz motor currents do not exceed 110% of 60 Hz levels.

\*\* 50 Hz timing = 1.2 x 60 Hz timing.



# NOTES

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# SERVICES

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## PRODUCT DEMONSTRATIONS

Each of Beck's Sales Engineers has access to a complete set of drive models so that he can demonstrate virtually any of their features at your location. In order to arrange to see a Beck drive in your plant or office, contact Beck's Sales Department.

## SITE SURVEYS

Beck Sales Engineers are available to discuss your process control requirements. Often a visit to your location is the best way to gain a thorough understanding of your needs, in order to meet them most accurately and completely.

Mounting hardware, torque requirements, linkage, control signal information, and optional equipment can be analyzed most effectively at the work site. Beck's analysis at the job site can help ensure that specifications are accurate, especially in the case of complex applications.

## APPLICATION REVIEWS

By sharing your needs with a Beck Sales Engineer you can take advantage of the best application advice for the type of control you need.

This review will yield a better understanding of the versatility of Beck drives for your installations, as well as complete details on options and accessories to make the process as effective as possible.

## SPECIFICATION WRITING

Beck provides specification writing assistance in order to help you specify and order the right drives for your applications. Beck Sales Engineers will work with you to make it easier for you to obtain the proper equipment and give you confidence that no details are overlooked.

## HOW TO OBTAIN SERVICE

Factory repair of drives or subassemblies is available for both normal and emergency service. To assure prompt processing, contact the factory to receive a Returned Material Authorization (RMA) number. If a repair estimation is desired, please send the name and phone number of your contact for service authorization. It is helpful to include a description of the work desired with the shipment or, in the event of a problem, the malfunction being experienced.

### THREE YEAR LIMITED WARRANTY STATEMENT\*

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Harold Beck & Sons, Inc. (Beck) warrants that our equipment shall conform to Beck's standard specifications. Beck warrants said equipment to be free from defects in materials and workmanship. This warranty applies to normal recommended use and service for three years from the date on which the equipment is shipped. Improper installation, misuse, improper maintenance, and normal wear and tear are not covered.

The Buyer must notify Beck of any warranty issues within 37 months of original shipment date and return the goods in question, at Buyer's expense, to Beck for evaluation. If the product fails to conform to the warranty, Beck's sole obligation and the Buyer's exclusive remedy will be: 1) the repair or replacement, without charge, at Beck's factory, of any defective equipment covered by this warranty, or 2) at Beck's option, a full refund of the purchase price. In no event will Beck's liability exceed the contract price for the goods claimed to be defective.

**THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES OF BECK. In no case shall Beck be liable for any special, incidental or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. Such damages include, but are not limited to, loss of profits, loss of revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of any substitute equipment, facilities or service, downtime, the claims of third parties including customers and injury to property.**

Buyer acknowledges its responsibilities under OSHA, related laws and regulations, and other safety laws, regulations, standards, practices or recommendations that are principally directed to the use of equipment in its operating environment. Buyer acknowledges that the conditions under which the equipment will be used, its use or combination with, or proximity to, other equipment, and other circumstances of the operation of such equipment are matters beyond Beck's control. **Buyer hereby agrees to indemnify Beck against all claims, damages, costs or liabilities (including but not limited to, attorney's fees and other legal expenses), whether on account of negligence or otherwise, except those claims based solely upon the negligence of Beck and those claims asserted by Beck's employees which arise out of or result from the operation or use of the equipment by Beck's employees.**

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\*Note: Internal water damage is not covered by warranty.

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Beck Control Drives are covered by the following patents: 3,667,578; 4,690,168; 6,563,412 B2; 6,639,375 B2 and 6,769,527 B1 with other patents pending.



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